## ON THE COVER

THE AMERICAN crossroads has changed a lot. In a more leisurely day people paused when they met there and passed the time of day, little concerned about traffic and little in a mood to hurry. Now there are many, many more crossroads and each one is a milling maelstrom of fume-spitting gasoline juggernauts, their drivers impatient at being held up for even a few seconds. If anyone speaks to another who crosses his path, the words are apt to be caustic or even blistering.

To avoid these complications, highway engineers have found ways to separate vehicles that are traveling in different directions. They solve the problem by putting them on different levels so that all may proceed full tilt and not have to care a whit about cross traffic. In New York City there are places where traffic moves on five levels. Suburban congestion hasn't yet reached the point where it needs such extreme treatment, but our cover picture shows a 3-tier structure at the Garden State Interchange on the New Jersey Turnpike in Middlesex County. Angling downward from the upper left is the extension of Main Street in Woodbridge. Crossing beneath it and passing from side to side is Garden State Parkway. The divided turnpike, running up and down, underpasses both.

●

## IN THIS ISSUE

RISING on the Columbia River just downstream from Grand Coulee is Chief Joseph Dam, largest man-built structure extant. An integral part of it will be a powerhouse designed to generate 1,728,000 kw, second only to Grand Coulee's 1,890,000-kw capacity. Our leading article describes the construction of this 220-million-dollar giant.

●

IN THE first decade of this century Nevada had half a dozen rip-roaring gold-mining camps, headed by Tonopah and Goldfield. Today only their shells are left, but they are filled with memories. Frank Miller, who knew them in their prime, tells of going back and, for good measure, describes his visit to Virginia City, metropolis of the nineteenth century bonanza Comstock Lode. Page 319.

●

TO produce 900,000 tons of stone for the paving of a 53-mile stretch of the New Jersey Turnpike, the Chimney Rock Quarry of the North Jersey Quarry Company has been operating at a 10,000-ton-a-day clip. Page 323.

●

TO IMPART a little Yuletide touch to this issue we present *Candles for Christmas*, page 330.


# Compressed Air Magazine


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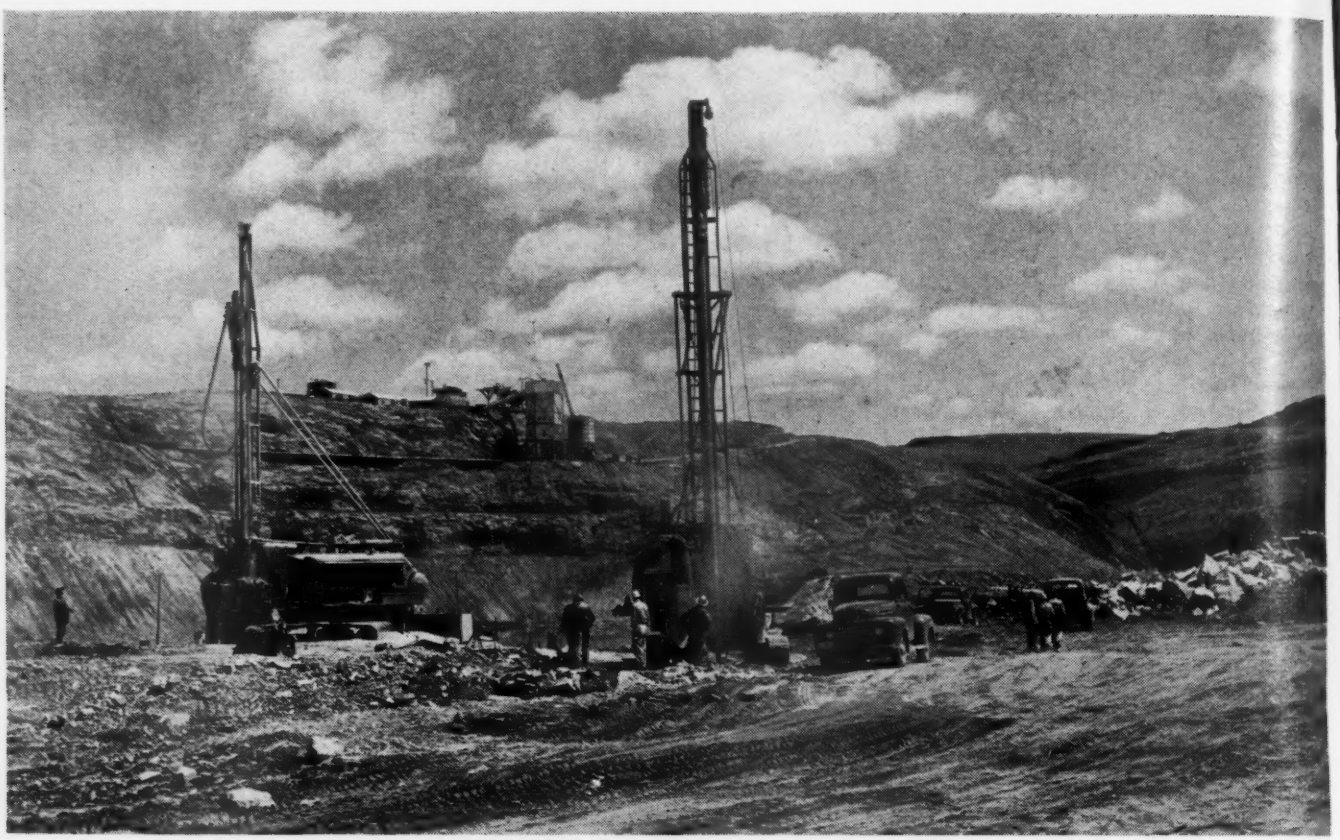
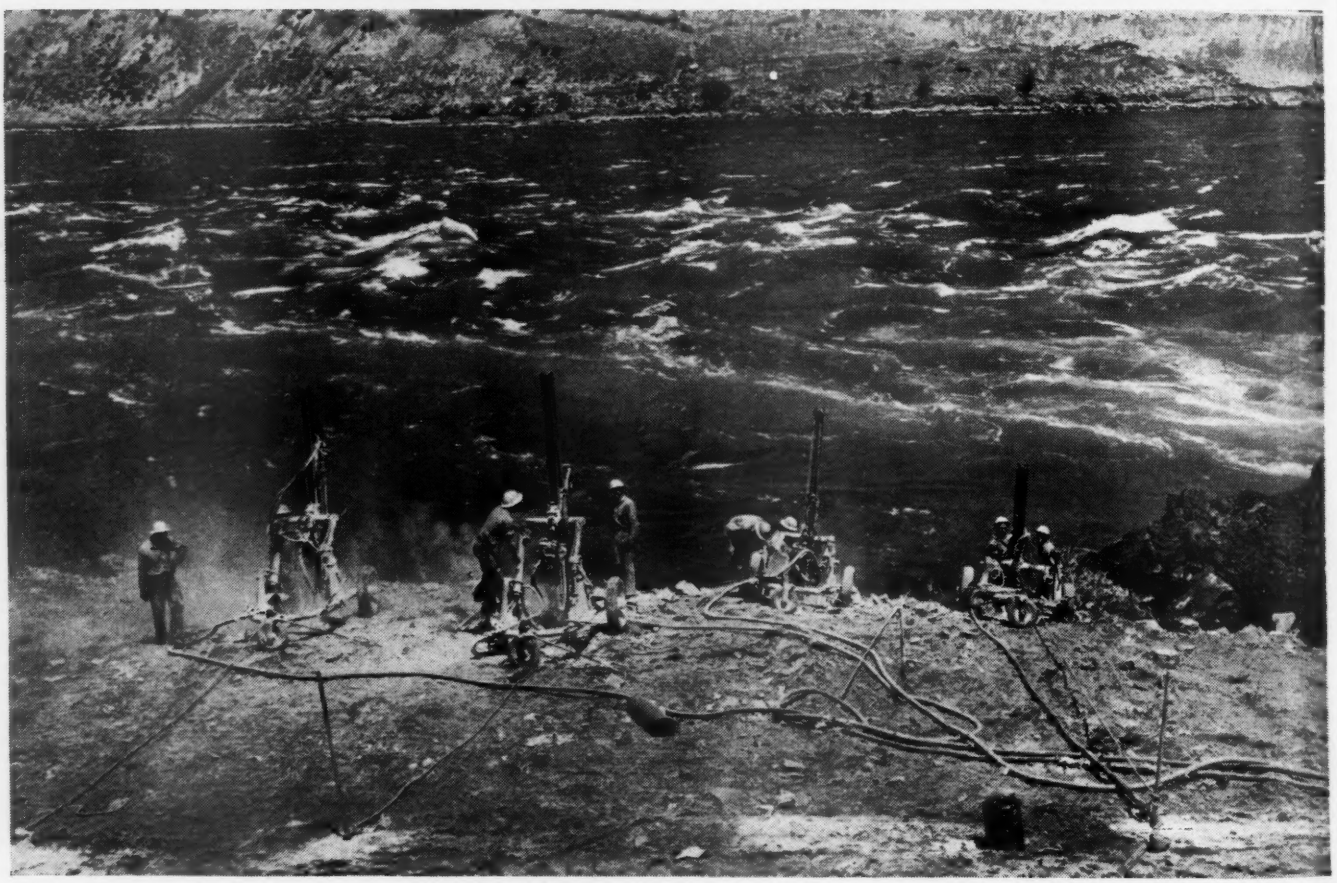
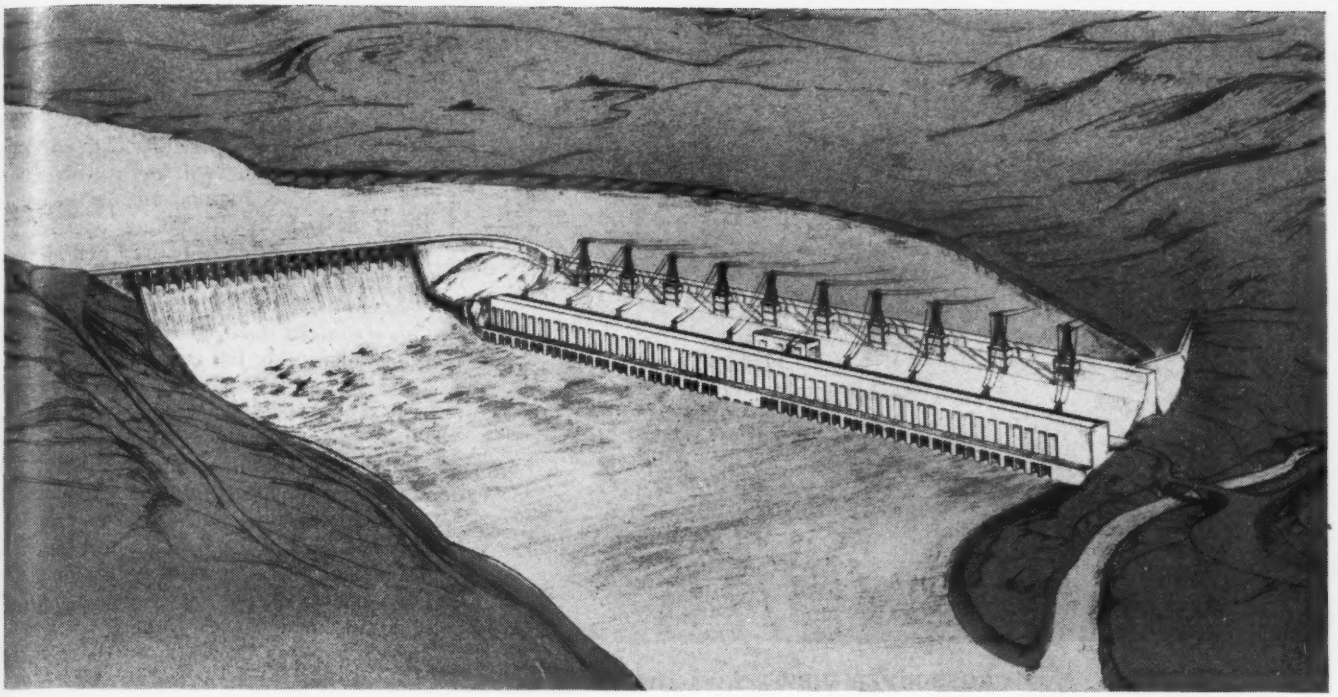




PHOTOS, CARL B. LEWIS

**QUARRYMASTERS AND WAGON DRILLS**

Heavy drilling is being done with the two Ingersoll-Rand air-operated Quarrymasters shown in the top view and with nineteen FM-3 wagon drills like the four seen at the bottom. The Quarrymasters drill 6-inch holes to maximum depths of 42 feet and work around the clock. The average hole is loaded with 150 to 175 pounds of explosive. The wagon drills put down 2-inch holes. Note the mooring lines to avert the possibility of their going over the bank into the raging Columbia. On the hilltop across the river in the upper picture is the concrete mixing plant that can turn out hourly 181 cubic yards of concrete which is cooled to 40°F.



**ARTIST'S CONCEPTION**

The gravity-type concrete dam will rise 220 feet above the lowest foundation level. The flow of water over its 922-foot spillway section will be controlled by nineteen crest gates, each 40 feet wide and 38½ feet high. The powerhouse will stretch out 2100 feet and be the longest in existence. It will ultimately house 27 generators with a combined capacity of 1,728,000 kw.

# Chief Joseph Dam

## Columbia River Structure Will be Nation's Second Largest Source of Hydroelectric Power

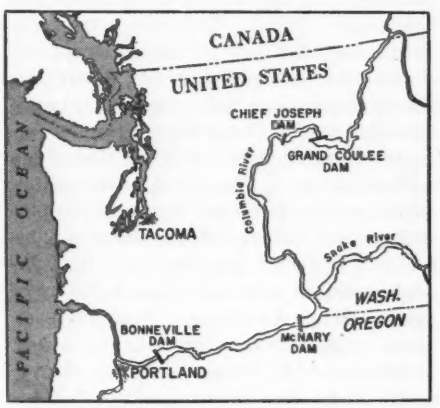
**L. A. Luther**

WHEN hydroelectric power produced on the Colorado River at Hoover Dam was used to raise a substantial volume of that stream to an elevation which permitted it to flow by gravity in the huge All American Canal to irrigate extensive areas and to supplement Los Angeles' water supply, a precedent was set. Now similar means of making a river lift itself by its own bootstraps are being applied to a stretch of the Sacramento in the northern end of California's Central Valley. Some of the impounded waters of this stream are being transferred to the southern San Joaquin watershed, where the demand for irrigating purposes has far outrun the supply and where pumping has brought the water table to alarmingly low levels. A still more daring scheme is now underway on the Columbia at Grand Coulee Dam. There that large river is being partially routed via its ancient Ice Age channel to reach large areas chosen for reclamation.

Our governmental agencies have other ambitious plans to checkmate the caprices of topography and weather as they endeavor to allocate the West's life-giving water. But in contriving to make streams of substantial size literally flow uphill, thus demonstrating their ability to do more than talk about the weather as well as the economy of a region, they use considerable power, and these requirements are added to those resulting from the West's incredible industrial expansion. As a case in point, the claim is made that 40 percent of the nation's aluminum is now produced in the Northwest, and aluminum is made by a process that consumes large quantities of electric current.

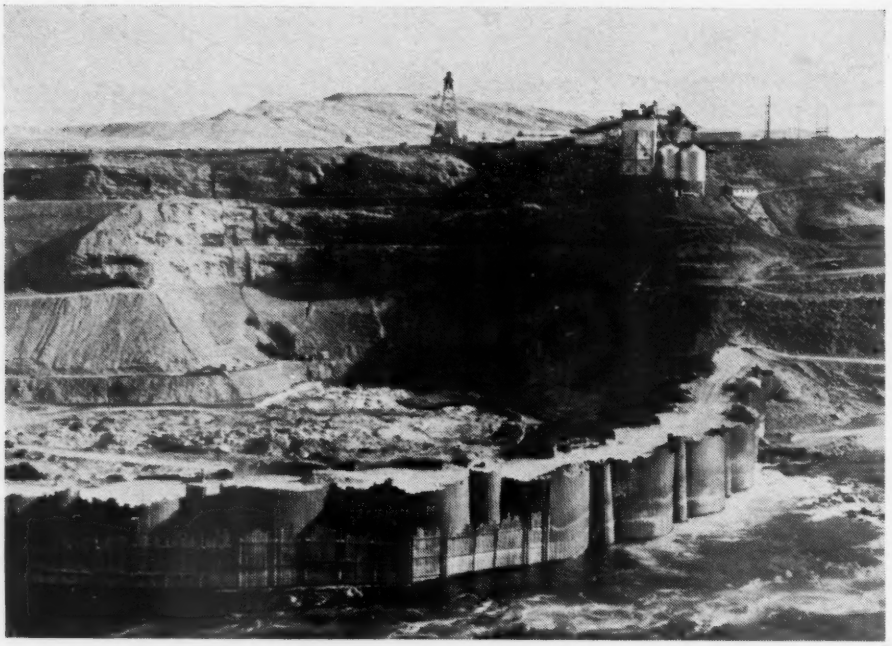
In carrying out the world's second-largest hydroelectric project on the Columbia River near Bridgeport, Wash., the Corps of Engineers, U. S. Army, is making a substantial contribution to the power pool of the Northwest. The 220-foot-high gravity-type concrete dam, with its separate station that will house 27 generators capable of developing 1,728,000 kw., will outrank Hoover, Shasta and Bonneville dams in power output. Even so, it seems to have received less public notice than any of the latter, perhaps because we have become accustomed to the building of large hydroelectric plants, or because this structure will back water upstream 51 miles to the tailrace of more spectacular Grand Coulee Dam with a productive capacity of 1,890,000 kw.

Among the unique features of the new dam is its name, Chief Joseph, which was picked by the Corps of Engineers to honor an Indian tribe of the Northwest, the Nez Percé, who befriended Lewis and Clark and whose chieftain, Joseph, achieved even greater fame as a patriot




**LOCATION MAP**

Chief Joseph Dam is being erected just downstream from Grand Coulee. Locations of other Columbia River dams in operation or under construction are also shown.



**CROSS-RIVER VIEW**

Looking across the first-stage cofferdam toward the south abutment and showing the supplemental outer wall or diaphragm which was erected for a distance of 325 feet in the deep and turbulent river to aid in sealing the cofferdam cells and keeping water out of the working area. On the far bank is the stationary tower of the cableway system which is used to transport concrete.

and magnanimous statesman than as a military leader. The single power plant on the south or left bank of the Columbia will be more than 2100 feet in length, the longest on earth it is claimed. Common-earth excavation will total 4,400,000 cubic yards; rock removal, including granite of varying hardness and till—a fill material of glacial origin to be used to resist water seepage—5,500,000 cubic yards. Some 1,700,000 cubic yards of concrete will be required, together with 70 million pounds of reinforcing steel and 30 million pounds of structural steel.

To improve haulage conditions from rail head at Brewster, Wash., to the site, the Corps of Engineers constructed 10½ miles of hard-surfaced access road and built steel bridges over the Columbia and Okanogan rivers. Two contracts have been completed: one by the General Construction Company, Seattle, Wash., for the powerhouse intake-channel excavation and one by Peter Kiewit Sons Company, Omaha, Neb., for the first-stage cofferdam and abutment excavation. Work now in progress on the $221,000,000 project is being done under a $25,967,921 contract awarded to Chief Joseph Builders, a combination made up of L. E. Dixon Company, San Gabriel, Calif. (sponsor); Arundel Corporation, Baltimore, Md.; Hunkin-Conkey, Cleveland, Ohio; and American Pipe & Construction Company, South Gate, Calif.

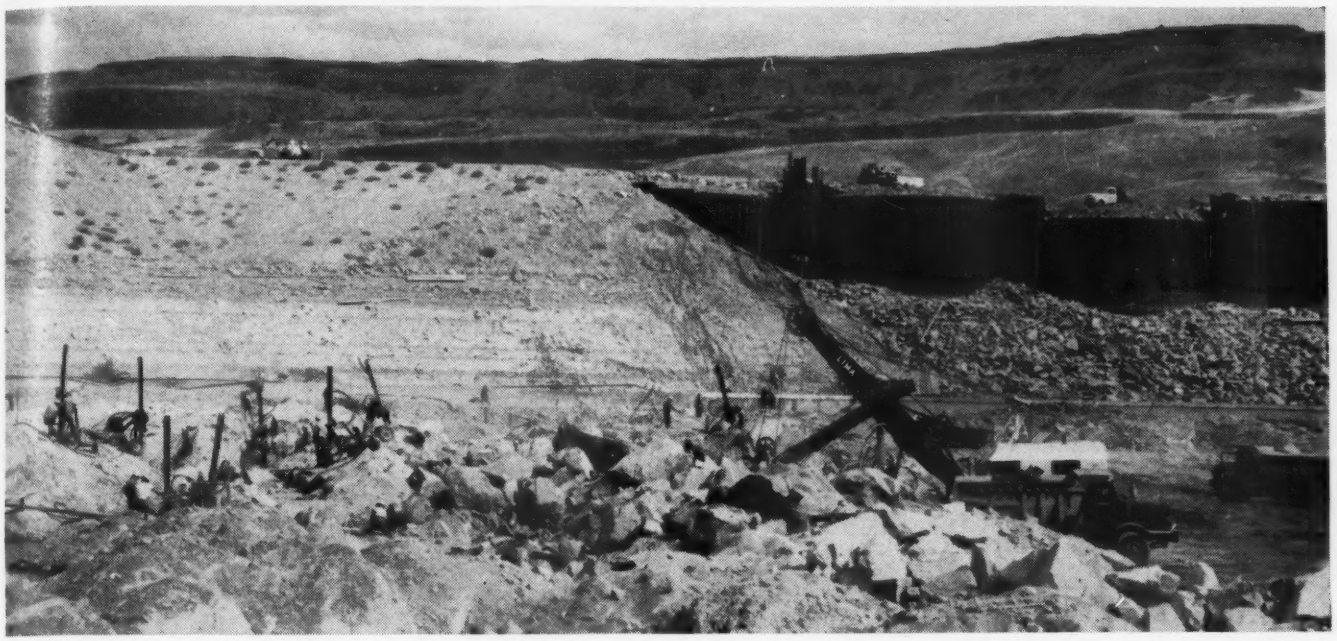
The volume of water carried by the Columbia, and the tendency of its watershed to create outsize floods, discourage diversion of the river by tunnel or open channel to permit the construction of dams. The Corps of Engineers chose to complete the foundation excavation and concrete placement of Chief Joseph Dam in two operations, each area representing approximately half of the main structure to be enclosed in a cellular earth-fill, steel-piling cofferdam.

In pouring concrete for the lower section of the first half of the dam, every other block is to be left low, and the channels so formed will serve as diversion spillways while foundations for the other half of the 1500-foot-long barrier are dug and the lifts are poured in a similar manner inside a second cofferdam. As concrete placement is carried to higher elevations in the first section, 10x14-foot openings will be left as temporary sluices and will later be closed with concrete plugs. The intake channel that will supply the turbines with water will be behind the power station and will be 3000 feet long, 1000 feet wide and 30 feet deep.

Chief Joseph Builders are now finishing the work of excavating and pouring concrete (the first permanent concrete was placed during the last few days of August, 1951) inside Cofferdam No. 1, which extends from the north or right bank to the center of the stream. They are also removing granite in the powerhouse area. Construction of No. 1 Cofferdam was one of the more difficult phases of the undertaking. The river bottom there is bare rock of very uneven surface, the water reaches a maximum depth of 70 feet, and the stream attains a flow of 640,000 cubic feet per second and a maximum velocity of 40 feet per second. Large circular steel frames were

**ROUGH RIVER BOTTOM**

This view inside the first-stage cofferdam shows the extremely uneven surface of the river bed. The men in the foreground are literally manicuring it preparatory to placing the first concrete for the dam. Drilling and excavating are underway in the background. The water at the lower right has seeped in under the cofferdam and is being diverted from the working area.

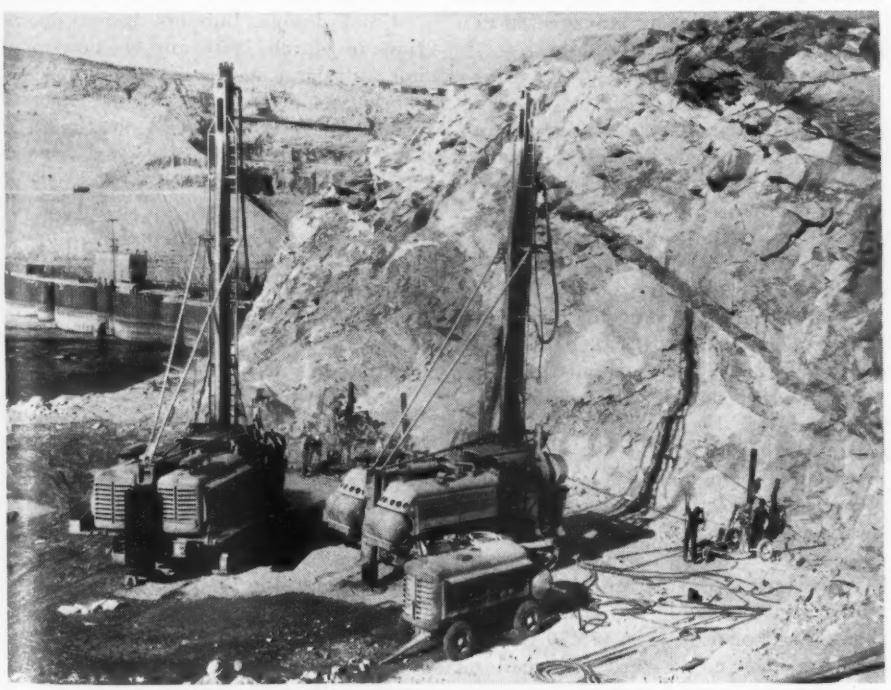


**PECKING AWAY**

The removal of 5,500,000 cubic yards of rock calls for a lot of drill holes. In this picture, eight wagon drills and several Jackhamers are shown at work while a Lima shovel loads blasted material into a 16-cubic-yard truck.

used as templates around which to assemble interlocking sheet-steel piling, and each of these cells was filled with earth and rock.

Under the existing conditions, which prevented driving the piling into the bottom, openings were left between the square-end piling and the ragged rock through which the surge of the turbulent waters sucked fill material out of the cells. In order to provide a reasonably watertight seal, part of the cofferdam was provided with a flanking 325-foot wall or diaphragm of sheet-steel piling that was guided in place by a tubular-steel framework, which also served to support the piling against the tremendous force of the water. Holes were put down 4 feet deep in the river bed, and in them were set 10-inch spuds connecting with 12-inch vertical pipe members. The tubular-steel framework was prefabricated, dropped by a crane over the sides of the cofferdam, and welded to the cells by 6-inch-diameter bracing studs. The outer diaphragm was sealed by placing bags of concrete along the bottom. Several reinforced-concrete diversion walls were built inside the cofferdam to conduct water to dewatering pumps and to protect the dam foundation for final excavation, inspection and concrete placement. Carl Tavares was subcontractor for Chief Joseph Builders on cofferdam construction, and Harvey Slocum, veteran dam builder, served as consultant.

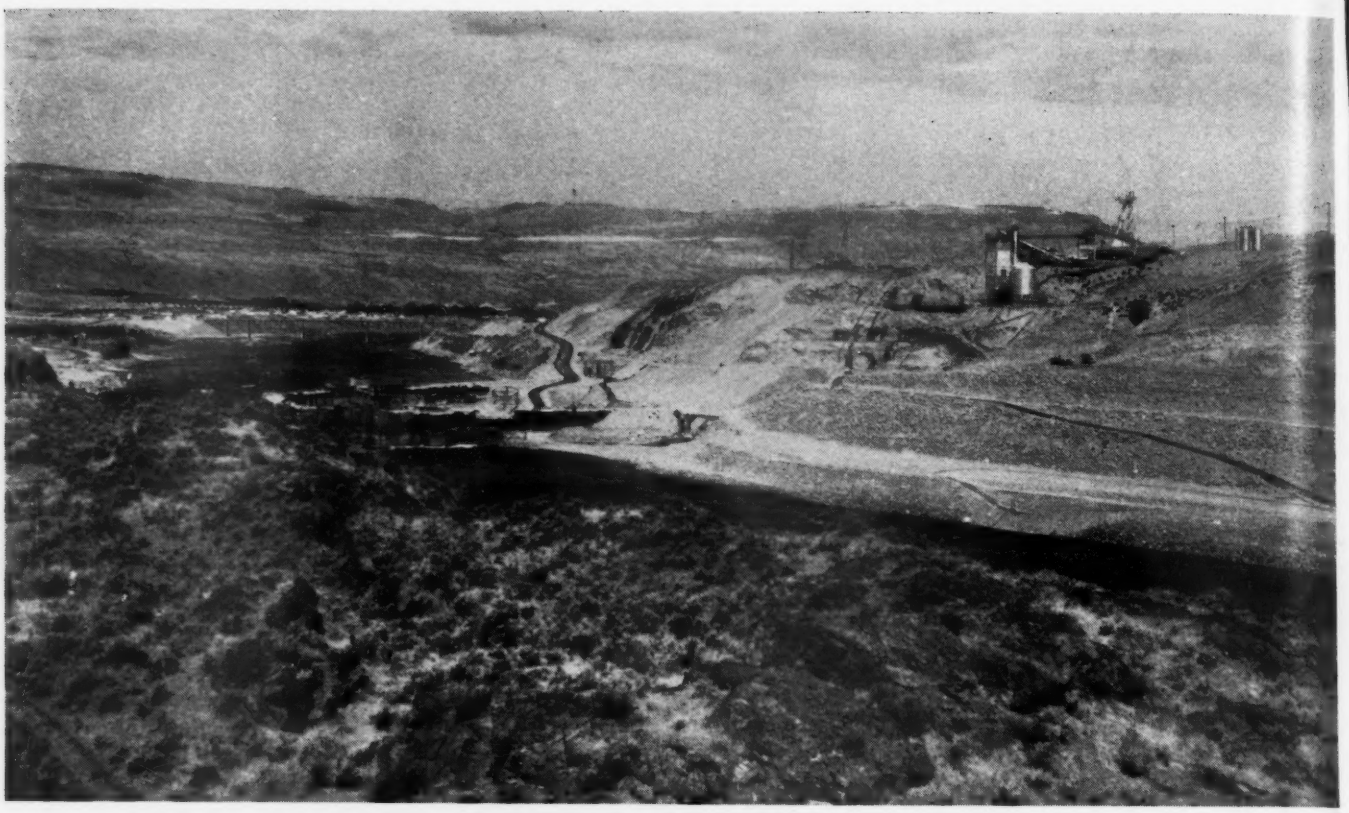


**TEAMING UP**

Quarrymasters and wagon drills shown working together in the powerhouse area. In the foreground is an I-R 500-cfm portable compressor furnishing air for the wagon drills. Quarrymasters carry their own air plants.

In removing the rock, Chief Joseph Builders have resorted to an innovation in drilling practice in the Northwest by supplementing their battery of nineteen Ingersoll-Rand FM-3 wagon drills with two Quarrymasters. These big machines put down 6-inch holes with Carset (tungsten-carbide insert) bits on drill rods actuated by large piston drills. Crawler-mounted and self-propelled, each is powered by two 500-cfm oil engine-driven compressors and can drill to a depth of 70 feet. In this instance, the deepest holes were bottomed at 42 feet. They were few in number, the bulk of them running from 27 to 35 feet.

The two drills were placed in service last March and had suffered no major breakdown up to the end of September. Wagon drills operate two shifts daily, but Quarrymasters have worked three shifts, with a 2-man crew on each drill. They average 12.5 feet of hole an hour, and the large Carset bits, hand-sharpened each shift, drill 1500 feet before being replaced. They have shown little tendency to fracture, and are suitable for resizing and further use after being shelved on this job. Drilling with Quarrymasters is costing 45 percent as much per cubic yard of rock broken as it does with



**GENERAL VIEW OF WORKING AREA**

Looking downstream from the south bank of the river. The town of Bridgeport is in the background and on the near side of it a new bridge that was built to facilitate truck delivery of materials. The first-stage cofferdam has enclosed half the river width for excavation. The concrete mixing plant is on the right.

FM-3 wagon drills in neighboring areas.

The large Quarrymaster holes are loaded with 150 to 175 pounds of 60-percent explosive, and any secondary shooting required runs about 2 percent. The general impression among personnel on the job is that the large drills, combined with big shovels and trucks, are unsurpassed for fast rock removal. Their mobility has come up to expectations, and their capacity to drill through as much as 12 feet of overburden at several points has made a strong appeal. Carset bits of 2-inch size are used with the wagon drills, and secondary and light-excavation drilling is done with J-50 Jackhamers. Steel is shanked and threaded in a shop equipped with a No. 54 sharpener and an SF-27 oil furnace. Rock spoil is loaded by six power shovels ranging in size from 3½ to 6 cubic yards and hauled in 38 Mack and Euclid trucks.

The dam's designers elected to avoid the dangerously high temperatures in finished concrete caused by heat of hydration or setting by placing the mix at very low initial temperatures. To achieve this, a complex Johnson plant, with elaborate refrigeration facilities, has been erected on the north bank. From there to the pouring sites, the concrete, along with other construction materials, is carried by two conventional overhead cableway systems with rail-mounted movable towers on the high bluff on the north bank and a single 240-foot-high fixed mast on the south bank. The three million tons of aggregates required are produced at a rate as high as 400 tons per hour at a plant erected in a pit some 3 miles from the dam.

Concrete specifications call for a relatively dry mix and close control of aggregates. There is an unusual feature in concrete making on this job, and that is the extent to which the aggregates are precooled before use. Coarse aggregates are chilled by circulating refrigerated air through them while they are in the batch-plant storage bins, an estimated maximum of 80,000 cfm being needed for this purpose. Sand is cooled in Holoflite conveyors with coolant passages through which pumps force water maintained at 34°F by circulating it through a tubular heat exchanger.

A temperature of 40°F is sought in the poured concrete, with provision in the specifications for placement at 50° when the plant is working at full capacity in hot weather. To effect the desired temperature control, refrigeration has been figured on a basis of 47,470 Btu, or 3.95 tons per cubic yard of concrete, these figures being based on a cooling range of 42.5°. Refrigeration equipment with a capacity of 1000 tons has been provided. Four 6-section freezers can each make 40 tons of ice in 24 hours. Ice production per hour is 13,330 pounds, and two storage silos have a capacity of 12,000 pounds each. This is supplemented by a 24x12x11-foot pit holding 198,000 pounds of water and ice, water for mixing concrete being chilled to 33-35° by 60 refrigeration elements suspended therein. Approximately 300 pounds of snow-ice is used in each 4-cubic-yard batch of concrete.

Chief Joseph builders began operations in March, 1951, and are now moving daily large yardages of rock on both sides of the stream and pouring concrete inside the cofferdam for the north half of the dam. This section will later serve as a spillway to carry the flow of the Columbia. The schedule for 1952 calls for the pulling of the existing steel-piling cofferdam and its reërection from the south bank of the river to a junction with the north half of the dam now underway. A contract for the construction of the large powerhouse will be let in 1952. The year 1953 will see peak employment on the project, which is scheduled for completion in 1956.

Col. J. P. Buehler is district engineer for the Corps of Engineers in the Seattle District, F. S. Brown is chief of the engineering division, Ray Bracelin is chief of the Chief Joseph Dam Branch, and C. H. Wagner is resident engineer. W. N. Evans is project manager for Chief Joseph Builders, K. L. Parker is chief engineer, T. C. Curtis is general superintendent, J. M. Cooney is field engineer, R. F. Murphy is excavation superintendent, and A. D. Haile is office manager.

# Nevada Mining Camps Revisited

## Former Resident Who Walked Out of Goldfield in 1907 Finds There Have Been Changes

**Frank Miller**

**TONOPAH IN ITS PRIME**

Legend has it that Jim Butler and a burro were joint discoverers of ore at Tonopah. A sizeable city blossomed quickly, and the Tonopah & Goldfield Railroad came to town. Some of the famous early mines were the Desert Queen, Burro, Mizpah, Silver Top and Buckboard. They gave way later to incorporated concerns of which the Tonopah Mining Company was the largest producer with a published total of $47,000,000 worth of mineral. There is little mining activity now, but large numbers of tourists find the old camp of interest. Tonopah is in the San Antonio Mountains, 6072 feet above sea level and the county seat of Nye County.

AFTER a lapse of 44 years, I once again walk down the road that was the main street of Goldfield, Nev. When I knew the place back in 1907 it was vibrant with excitement—"there was gold in them thar hills." Today I see it as through a mist. I try to recall and visualize the varied happenings of the past, but it is difficult with the present-day picture that confronts me. The old mine dumps and a few headgears are the only evidences that it was once a bustling mining camp. It is hard to believe that in its heyday it had a population of approximately 30,000.

Goldfield was born in 1902 during a period of boom camps. First came Tonopah in 1900, and then, in a cycle, followed Rhyolite in 1904, Rawhide in 1906 and many others. Those were the days of the passing of big money in mining deals. Charles Taylor gave Senator Nixon and George Wingfield a verbal option on the Jumbo and Red Top for $1,200,000. The Combination Mine was sold to Goldfield Consolidated for $5,000,000. These are only two illustrations of the many mining transactions which were consummated around that time.

In 1906 further attention was drawn to Goldfield by the offer of a purse of $30,000 for the lightweight championship bout between Joe Gans and Battling Nelson. The former was to receive $10,000 and Nelson $20,000, whichever way the fight went. Gans won from Nelson on a low blow in the forty-second round on Labor Day. Goldfield was a haven for high-graders. With such rich ore discoveries, it was a temptation for the miners to help themselves, and in this they were abetted by the free and easy assay offices that flourished there.

Many of the buildings on Main Street were destroyed by the big fire of July, 1923, and only some walls and foundations mark the locations of the old saloons and gambling houses. In one of the former, the famous Northern Saloon owned by Tex Rickard, I recollect a big bouncer whose job it was to throw out the customers who got out of hand. Finally it reached a stage where it became even a bit too rough for the bouncer, and it was hard to keep the job filled. So someone hit upon the idea of employing a little fellow, with the result that when the barkeeper gave the order to put a rowdy out, and the latter turned on the little fellow, all the other customers would take over and toss out the unruly one.

In the local burial ground can be found evidences of tragedy and sorrow. There is the grave of a Russian count who was shot for running off with another man's

**GOLDFIELD AS IT WAS**

In a few years after the discovery of mineral, Goldfield sprang out of the desert to become the largest city in Nevada. Its peak annual production of around $10,000,000 worth of ore was reached in 1910-11. A single shipment of 47 tons from the Hayes-Monette lease on the Mohawk Mine to the Selby Smelter in San Francisco in 1907 netted $574,958.39, an all-time record for a carload lot. By 1918 Goldfield's decline was well underway, but it has had sporadic revivals since then. Columbia Mountain is in the background of our picture.

wife. The husband was arrested but "somehow" he disappeared. Then you will come across the resting place of a little girl of seven. As a headstone, it has a concrete block which was stolen from a building by her mother who tried to chisel in the name.

Through Goldfield now passes a fine highway that extends south to Las Vegas. Going northward, it runs partway parallel to the old railroad that used to chug across the desert. The rails have been torn up, and all that remains are some of the old ties. The writer well remembers walking the 26 miles from Goldfield to Tonopah through the hot sand and sagebrush. It is a far cry from those days, for now you glide along on a smooth roadway and reach Tonopah in 35 to 40 minutes. Goldfield is left behind with a feeling of sadness that all the past glory of this high-grade camp should end in just a whistle-stop for the motorist.

Outwardly, at least so far as Main Street is concerned, Tonopah has the appearance of a firmly established camp, but from the standpoint of mining it is dead. Though only a few abandoned headgears and dumps slaking in the hot desert sun remain to tell the tale, still Tonopah seems to survive as an interesting mining town of a bygone era. It gives one the impression it is only sleeping and refuses to fade out. Its Mizpah Hotel of five stories, surrounded by the present business district, continues to carry on, and a famous club flourishes at the expense of tourists and a few local inhabitants.

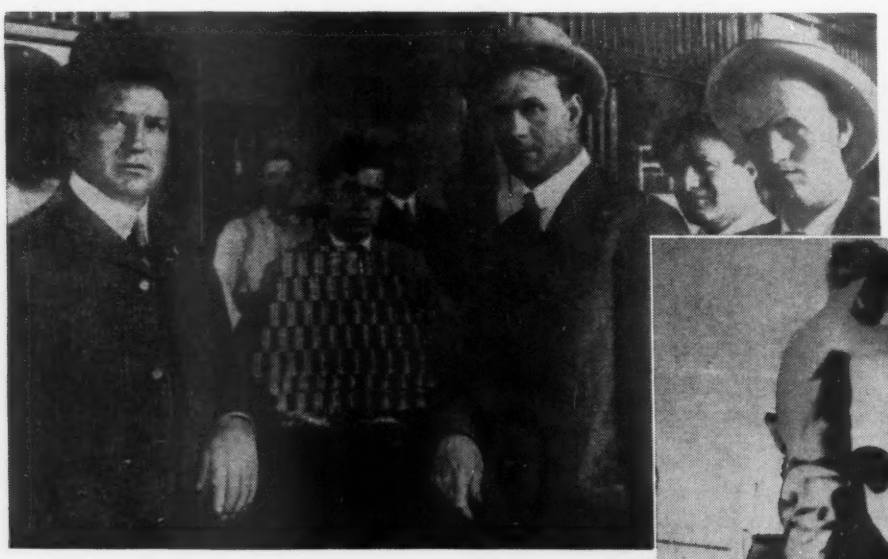
**ROCK-DRILLING CONTEST**

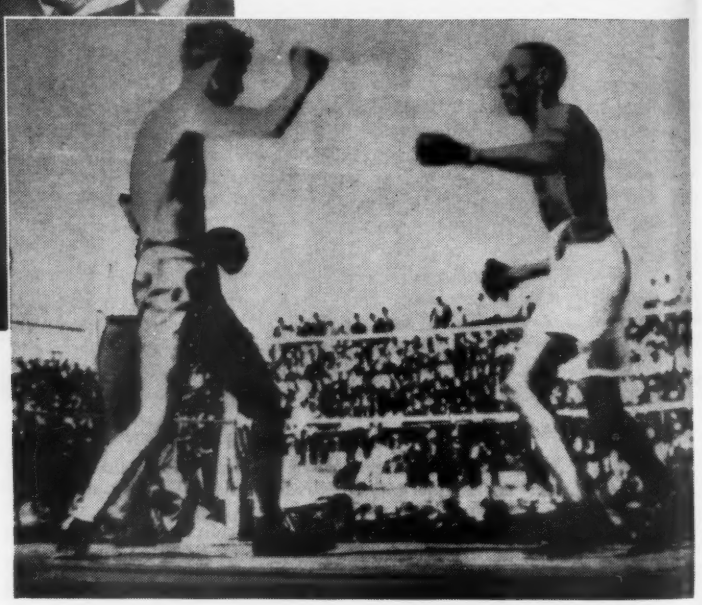
Goldfield miners, in 1909, perched on roof tops to watch their buddies determine who could pound the deepest hole in a block of granite in a set time. Here an unidentified left-handed single-jacker is bearing down on the rock while an attendant feeds water into the hole from a barrel.

It was on May 19, 1900, that Jim Butler made the original discovery of the Mizpah Vein which yielded approximately $200,000,000 in gold and silver. Up to that time Jim's possessions were assessed at $10; for his claim he was offered $365,000, which he accepted. The following extract from an article by the late Clyde Terrell—one of Tonopah's greatest admirers—brings to light a meeting between him and Butler shortly before the latter died.

"We met on a Sacramento street one hot afternoon. Jim was walking in an aimless sort of way, a wide-brimmed hat pulled down on his forehead, his trousers loose and wrinkled as always. I recognized him instantly, but he didn't know me. As we came abreast I looked at him, and said just one word—'Tonopah.' An instant change came over Jim. He looked hard at me, probing his memory. 'What do you know about Tonopah?' 'Remember the kid, fresh from Tuscarora who used to deliver milk to the old Miners Exchange where you used to wait for your steaming eggnog each winter morning?' Jim roared with laughter and thrust out his hand, now soft and pudgy. 'This calls for a drink,' Jim said. 'Come on, I know a bootleg joint right close by.' It was during prohibition, but Jim knew where to go.

"It was evident everybody knew Jim,





**MINING-CAMP DIVERSION**

Goldfield wanted its fun and was willing to pay for it. In 1906 it raised $30,000, then considered a huge purse, to attract the Joe Gans-Battling Nelson lightweight boxing bout for the world championship. The money, all in $20 gold pieces, was put on display. It is seen above in front of Tex Rickard, the promotor of the bout who later became the nation's premier fight arranger in New York City. Nelson, left, and Gans are shown at the right squared off in the outdoor ring on September 3. Gans won in the forty-second round.

**VIRGINIA CITY TODAY**

Streets that once teemed with humanity are now virtually empty (bottom view) except when tourists come to town. Once substantial buildings are falling into ruin and many others have burned down or been removed to salvage their materials. Still in good repair is St. Mary's Catholic Church, erected in 1876 and renowned for its architectural beauty. It is visible at the right in the view below. Shown at the left are what remains of the 2-story vault of the Consolidated Virginia Mining Company which harbored ore worth millions of dollars. Located by Peter O'Riley and Patrick McLaughlin, the mine was acquired in 1871 by Mackay, Fair, Flood and O'Brien. In 1873 the fabulously rich strike christened "The Great Bonanza" gave the owners the title of "Bonanza Kings."

and we soon bellied up against a bar, drinks in front of us. 'Boy,' he said after a bit, 'if we could only see days like them again—but we never will. Cars and good roads have killed off the desert. Big mines might be found all right, but developing them and making them pay will be just a strict business matter. There'll be no more hard work, grubbing and suffering as we knew it. No sir, just so many men put to work, so much machinery to buy, cold business from start to finish. No more camping out under the stars with a pot of beans cookin' and scentin' up the desert air for tomorrow's grub.' Jim picked up his second glass of whiskey and stared down in it. He had gone back forty years. Perhaps, in memory again he was drinking that spicy eggnog in the Miners Exchange.

"That was the last time the writer saw Butler—there in that Sacramento speakeasy. We finally went back on the sidewalk. We shook hands, Jim went one way I went another. I turned and looked back; he was ambling along, steady, sober, shoulders drooping. For an hour or so Jim had dropped back to those early days of Tonopah when he was still young, powerful, fortune in his grasp. Now he was old again, most of his money gone, most of his life gone, most of his spirit gone."

Now we find Tonopah 51 years later still carrying on, looking forward to what tomorrow may bring forth. Who is to say that below the desert there is nothing more worth while. There is still a lot of country around Goldfield and Tonopah, with perhaps many a hidden ore body waiting for the day when another Jim Butler will reawaken these two old camps.

Leaving Tonopah in the early morning for Virginia City, a distance of 225 miles northeast, one passes Millers 12 miles out. Now returned to the desert, only stumps are left of the old mill building where thousands of tons of ore from Goldfield and Tonopah were treated. Virginia City lies at an altitude of 6205 feet and 2000 feet above the Carson Plains. Mount Davidson was originally called Sun Mountain and rises 1662 feet above the town. At nearby Silver City is the grave of Hosea Grosh, one of the discoverers of the Comstock Lode. The other was his brother Allen. Both men had a sad end. Hosea stuck a pick in his foot, inflicting a wound from which he died a few days later. Allen got caught in a snowstorm in the Sierra and had both feet frozen so badly that amputation was necessary. He never recovered

from the shock. That was in the fall of 1857.

From records, it would appear that the name Comstock Lode came from a trapper who lived in the Grosh cabin after the death of the brothers and who learned their secret. Selling out his claims for $10,000, he left for the Northwest and never realized that he had had millions in his grasp. So much has been written about the hectic days of the Comstock Lode that it will suffice here to present only a few of the high lights of this famous old Nevada mining camp.

Virginia City, Gold Hill and Silver City are practically all connected within a stretch of 3 miles. Virginia City is approximately 23 miles south of Reno across the Truckee Meadows and 9 miles from the point where one branches off onto the Geiger Grade, one of the finest mountain roads in Nevada. From the Geiger Grade Lookout there is a magnificent view of the valley, and a few miles farther on Virginia City comes into view around a bend in the highway. Looking down, you might expect to see something that would clearly indicate mining country, but all that meets the eye are the old mine dumps—the headgears have been removed. By their size, the dumps indicate that there must have been considerable underground activity which, it has been reported, yielded approximately $400,000,000. Production up to 1871 was 60 percent silver and 40 percent gold; later returns were somewhat in favor of gold.

The Comstock Lode brought into prominence such names as John W. Mackay, James Graham Fair, James C. Flood, W. S. O'Brien and many others well known in the world of finance. Another outstanding figure was Adolf Sutro, who formed a tunnel company for the purpose of draining the mines. Tunneling was commenced in October, 1869. By July 1878 the bore had reached the Savage Mine, a distance of 20,498 feet. Inside the timbering, the tunnel was 7 to 7½ feet in height, 8 feet wide across the top and 9 to 9½ feet across the bottom. The cost of construction up to that time, according to Theodore Sutro, was $3,500,000.

It must be remembered that the work was started in the days of the single- and double-jack miner; there were no high-speed rock drills*—no mechanical muckers—none of the present-day mining machinery. What equipment was used in the early years of the camp was brought in by river steamer from Sacramento and then by wagons over the roughest of roads through the Sierra, a 10-day trip at the best. Now the run from San Francisco, the real commercial center of the West which lies farther south, can be made by auto in a few hours.

The only remaining points of interest for the tourist are the old saloons such as the Bucket of Blood and the Sawdust Corner. There is a considerable number of them, and each has some attraction binding it with the past. In Virginia City you will find the old newspaper office of the *Enterprise* where Mark Twain worked as a reporter, and also the famous Piper Opera House on whose boards appeared many stage celebrities of days gone. All very interesting to the tourist, perhaps, but to an old-timer who knew the places when they throbbed with life it is too much like a side show. You come away with a sense of sadness, especially so after a visit to the old Bowers mansion on the highway 9 miles from Carson City. Buried in the woods back of the house, which is open to the public, lie Lemuel S. Bowers, familiarly known as "Sandy," Eilly his wife, and Persia their adopted daughter. He was one of the first of the Comstock millionaires, but with all his riches the ending of the family was one of the tragedies of that golden era.

According to accounts that have been handed down, Eilly Bowers was born Eilly Orrum of poor Scotch parents and brought to this country at a marriageable age at the time the Mormons were seeking more wives for their colony in Utah. Eilly was married to an elder in the church, who became a bishop seven years later. In 1852, after ten years of married life without children, Eilly was informed that three of her husband's supposed nieces were actually other wives, and she obtained a divorce.

A short time later she married another Mormon and left the Salt Lake area with him by wagon train, finally arriving after many hardships in the Washoe Valley in western Nevada. It was not long until members of the church, her husband among them, were recalled to Salt Lake, but Eilly refused to go and so her second marriage ended.

To subsist, Eilly opened a boarding house for miners and also took in washing. One of her boarders was Sandy Bowers, who had come across the plains and mountains from Missouri, and he became husband number three. To make Eilly feel good and sort of kid her along, some of the miners staked claims for her, making certain, however, that they were located high up in the porphyry formations that were supposed to be barren of ore. But they were wrong about that, so much so in fact that it wasn't long until the Bowers were building a $250,000 mansion with silver doorknobs and imported tapestries. To get rid of some of their money, they went abroad to buy furnishings.

Having struck it rich through no fault of her own, Eilly, strangely enough, came to believe that she possessed occult powers that enabled her to locate ore, but she was never able to prove it. She and her husband spent money lavishly for a time and then had a rude awakening. When the mines began to play out they put up cash to keep them going and eventually mortgaged their home and finally saw it sold under the sheriff's hammer for $10,000.

Sandy Bowers died in 1868, aged 38. His wife lived until 1903 and died practically penniless. The once fabulously rich Bowers Mine is now only a hole in the ground—a somber reminder that all good things come to an end.

*EDITOR'S NOTE: Drilling was done by hand until September, 1872, when diamond drills were tried, found unsatisfactory and discontinued. In April, 1874, rock drills made by Charles Burleigh, of which 40 had been employed as early as 1866 in the Hoosac Tunnel in Massachusetts, were brought in. In all eight were purchased and the records indicate that some 13,300 feet of the bore was driven with their aid.

**MARK TWAIN WORKED HERE**

An undated picture of the "composing room" of the "Enterprise," where young Sam Clemens gained writing experience. Type cases are at the right, proof press in the center.

# Ten Thousand Tons of Crushed Stone a Day

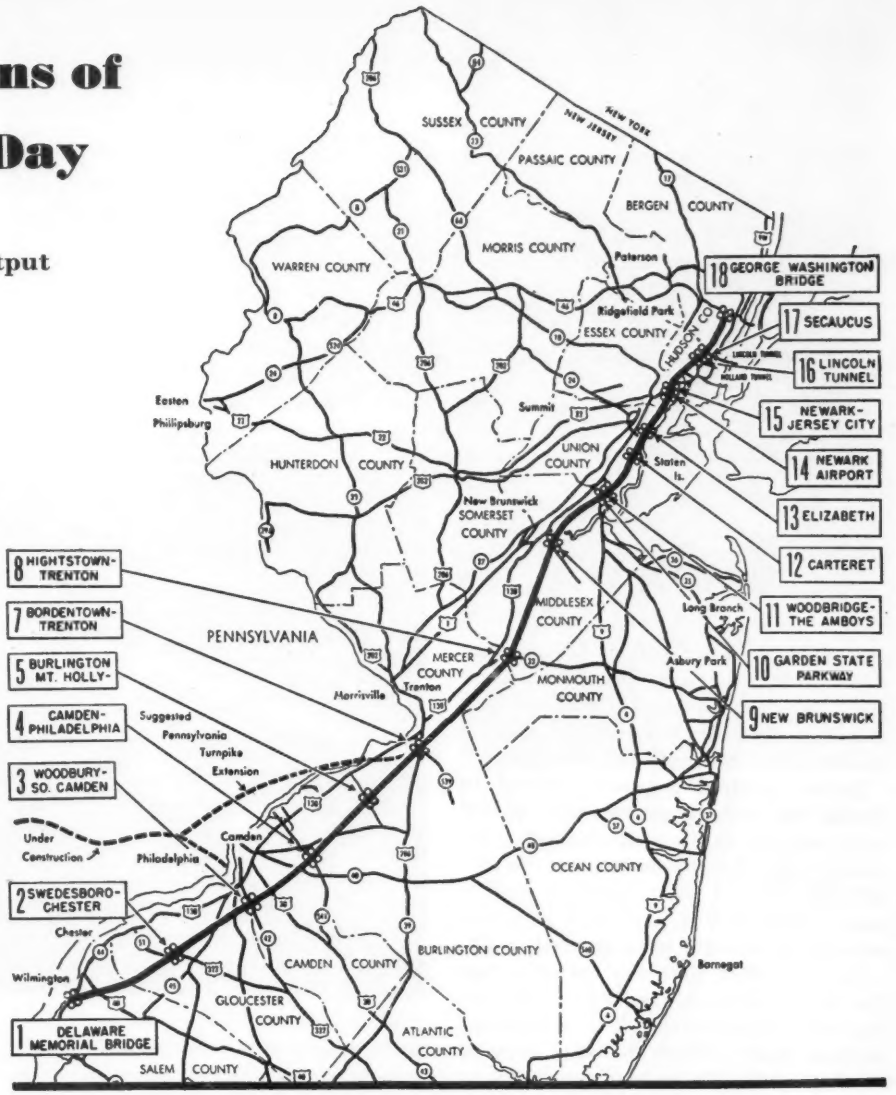
## Chimney Rock Quarry Boosted Output to Fill Contract for Paving of New Jersey Turnpike

**Albert S. Keshen**

EARLY next month the New Jersey Turnpike, a $250,000,000 superhighway, will be open for travel throughout its 118-mile length. It runs southward from Ridgefield Park, near the George Washington Bridge across the Hudson River, to Deepwater on Delaware Bay. A 54-mile section between Deepwater and Trenton was opened on November 5, and a connecting link extending 56 miles northward to the Newark-Jersey City interchange went into service on November 30, leaving only about 8 miles at the northern end to be finished.

This divided expressway is designed for safe travel at high speed. It has no intersections at grade level, no traffic lights, and will be closed to pedestrians and cyclists. By speeding up motor travel it will have the effect of extending the commuting range of workers in the northern New Jersey metropolitan area southward a good many miles. Surveys indicate that it will attract hundreds of commercial enterprises and lead to the building of thousands of new homes.

The speed limit has been set at 60 miles an hour, which is 10 miles less than on the Pennsylvania Turnpike but 10 miles more than is permissible on New Jersey state highways. With no cross traffic to cause trouble, it is estimated that the 90-mile trip from New York City to Camden-Philadelphia will be shortened by approximately one hour.




**TURNPIKE ROUTE**

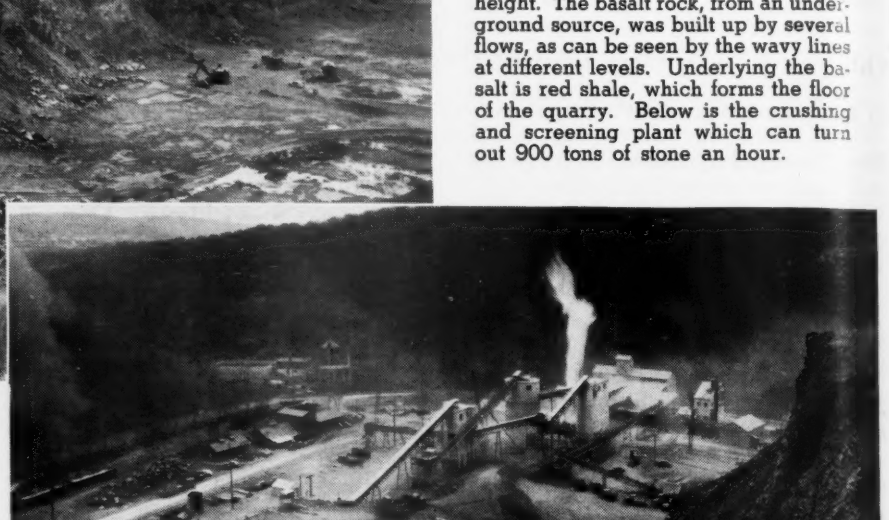
Extending 118 miles, the thoroughfare will link the parkways of New England with main highways to the West and South. Locations of interchanges are indicated and identified. No. 6 is being reserved as a point of access for the proposed extension of the Pennsylvania Turnpike shown by dotted line.

Motorists may enter or leave the expressway at any one of eighteen interchanges and will pay tolls varying in amount with the distance covered. Studies made by the New Jersey Turnpike Authority before construction was begun indicated that 9,910,000 vehicles might be expected to use it during the first five years of operation, with annual revenues, including returns from concessions, averaging $10,030,000. The bonds that were issued to finance the undertaking run for 35 years.

Sections of the northern end, which skirts a densely populated area, have six lanes with provisions for two more. From that zone southward to Deepwater there are four lanes, to which

**VIEW ON PIKE**

A toll booth on the southern section of the turnpike, which was opened on November 5.



**CHIMNEY ROCK QUARRY SCENES**

These pictures were taken from the same point by changing the angle of the camera. A general view along one wall (left) shows the vertical working face, which is up to 200 feet in height. The basalt rock, from an underground source, was built up by several flows, as can be seen by the wavy lines at different levels. Underlying the basalt is red shale, which forms the floor of the quarry. Below is the crushing and screening plant which can turn out 900 tons of stone an hour.

two may be added later as far as Camden. Along the route are 283 concrete and steel structures, the largest of which is a 7100-foot bridge across the Passaic River in the north Jersey "meadows."

Seven hundred engineers helped to design the superhighway, and 10,000 men worked on its construction. Its bridges and elevated structures contain 200,000 tons of steel, and 51 million cubic yards of dirt and sand were excavated or brought in to be used as fill.

It is claimed that the turnpike has the world's heaviest roadbed: a 4½-inch top layer of hot-mix asphalt, a 6½-inch subbase and a 7½-inch base, both of crushed rock. Under the base is 18 to 24 inches of frost-free material. The highway can, consequently, carry the heaviest trucks with a substantial margin of safety.

To provide stone for the base and paving of the 53-mile stretch from Raritan to Moorestown, the Chimney Rock plant of the North Jersey Quarry Company increased its daily output to 10,000 tons. It has supplied all the stone used by one of the principal paving contractors, George M. Brewster & Son, of Bogota, N. J.

Located in Bridgewater Township, Somerset County, in the first range of the Watchung Mountains, the quarry gets its name from a local landmark, a nearby rock formation shaped like a chimney. The latter is painted white so that it can be seen from a considerable distance. It has long been a favorite spot for Sunday walks and family picnics.

Catering to the public interest, William Haelig built a hotel there a good many years ago. Soon he saw the possibility of reaping a side income by working the abundant outcropping of igneous rock and started quarrying operations on a small scale in 1890. The business grew gradually, and upon the founder's death was sold to the present owning corporation, which also has other quarries and processing plants in northern New Jersey.

Quarrying on a large scale was begun about twenty years ago. Since then a vast U-shaped pit has been excavated with an over-all working face around 1600 feet long, and there is a big supply of rock as yet untouched on the company's property. The height of the face varies from 130 feet to a little more than 200 feet. The rock is classified as a basalt and exhibits the vertical columnar structure characteristic of rocks of that type. Designated in the trade as trap rock, there is a good demand for it as an aggregate in concrete and asphaltic pavements and for general concrete work. Large blocks of stone are also shipped to the coastline for use in jetties and breakwaters.

The basalt, rising from an underground reservoir in a past geological age, was evidently deposited in several consecutive flows, because there are distinct separations at two levels. A trace of silver is found, and occasionally a sizable chunk of native copper gets into the crushers and causes trouble until it is gouged out.

Having contracted to furnish about 900,000 tons of stone of varying sizes to the Brewster firm, which installed the largest asphaltic-mix plant in the East at Cranbury, N. J., the quarry management moved quickly to expand production. The latest time-saving machinery and equipment available were added, and the working force increased to more than 150. The workday was lengthened from 10 to 11½ hours, with one section of the plant on a 24-hour schedule. New areas were cleared of timber and shrubbery, and the 6-foot layer of soil overlying the rock was removed by power shovels and trucks.

Because the basaltic formation is remarkably consistent, drilling follows a regular pattern. Vertical primary blast holes, 6⅝ inches in diameter and spaced from 20 to 26 feet apart, are put down with churn drills. They are carried to within 2 feet of the quarry floor and range in depth from 130 to 205 feet. As it is desirable to maintain a vertical working face, care is taken to square it up at the bottom prior to setting off the main blasts. As a first step, all loose and broken material is removed from the area with the aid of a bulldozer and power shovel. Then toe holes, inclined slightly downward from the horizontal, are drilled into the base of the cliff with Ingersoll-Rand 505 drifter drills on wagon mountings. These holes are

loaded and fired, and the broken material is removed before the vertical holes are shot.

The large holes are loaded with 40- and 60-percent gelatin dynamite in 5x24-inch cartridges "decked" or spaced to produce the desired breaking effect, with ⅜-inch stone serving as stemming. Delay blasting caps are used, and holes are interconnected with Primacord fuse and wired in series. Firing is done with 440-volt current. Blasting usually takes place every two or three weeks, depending upon rock requirements.

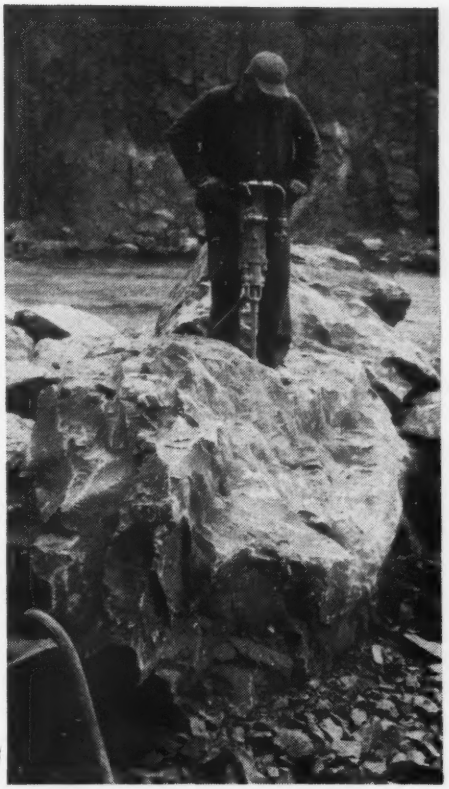
Great care is exercised not only to protect surrounding buildings and homes from damage through concussion but also to prevent rock from flying and thus to confine it within a small area for handling. In order to check upon the effects of the explosions, a small glass structure, resembling a miniature greenhouse, has recently been set up at about the center of the quarry floor within 200 or 300 feet of the closest blasting area. The panes are of varying sizes corresponding to those ordinarily found in windows.

Blocks of broken material that are too large for the shovels are reduced with a 6000-pound steel ball handled by a Northwest crane, or are fractured with small amounts of explosive placed in holes drilled with Ingersoll-Rand Jackhamers. Carset (tungsten-carbide-insert) bits are used with both wagon drills and Jackhamers and average 500 or 600 feet of hole before being discarded. They are reground as needed in a central shop that is maintained by the company at Summit, N. J.

Compressed air for operating the drills is normally supplied by an Ingersoll-Rand Type XPV steam-driven machine of 732-cfm capacity. It is in the plant engine room, and air is piped from it to various parts of the quarry. Additional air required on the Brewster contract was obtained from two rented portable compressors of 500- and 315-cfm capacity.

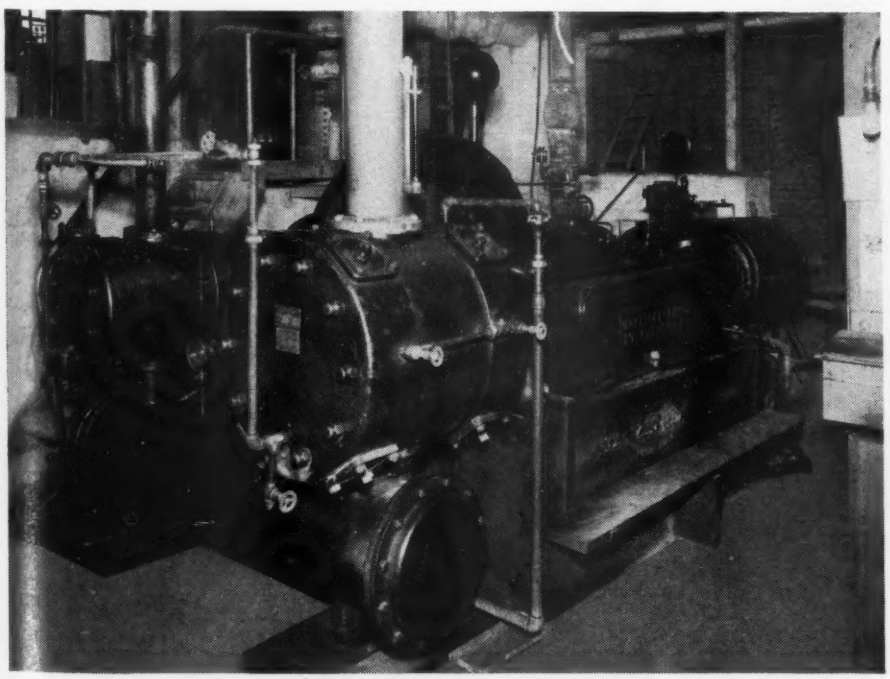
Broken rock is loaded by five Bucyrus-Erie shovels—three electrically operated Model 75-B's and two 54-B diesels—into six Mack gasoline- and twelve Euclid diesel-powered end-dump trucks. The haul to the primary crusher from the far end of the quarry is 1800 feet and from the near end only 100 feet.

Primary crushing is done by two Traylor motor-driven 48x60-inch units with capacities of 500 tons an hour each. From them the crushed material is conveyed by a 48-inch belt, capable of handling 1200 tons an hour, to a 6x16-inch Robbins Gyrex screen, where minus 2½-inch stone is separated. The larger material goes to two 5½-foot Traylor crushers for further reduction, and the product to two more 5x14-inch Robbins Gyrex screens where different sizes are obtained. Some material also goes to another part of the mill where, with the aid of six crushers, it is broken down and screened into several fine sizes which are delivered to individual bins, ready for sale. Even while fulfilling the Brewster contract, the quarry was able to take care of other customers promptly. End products are shipped by either truck or Jersey Central Railroad, a spur of which extends into the property from Bound Brook. Gasoline-engine locomotives are used for switching cars in the yard.



**BLOCKHOLING LARGE CHUNK**

Some pieces of rock brought down by primary blasts are too large to be handled and are drilled for secondary blasting with Jackhamers, as shown here. Other chunks of this size are shipped to seashore points for use in jetties and breakwaters.



**VENERABLE COMPRESSOR**

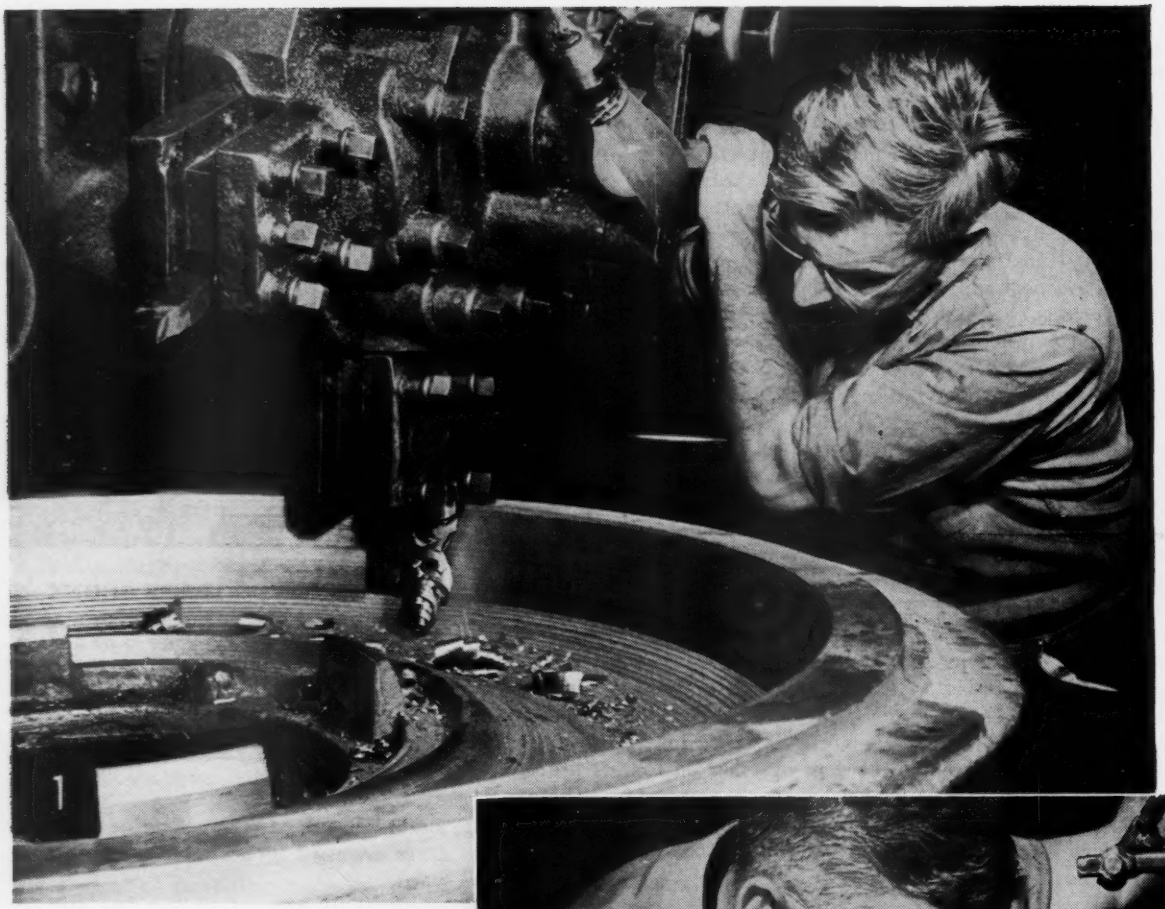
This Ingersoll-Rand steam-driven machine has been in continual service since January, 1924, and normally supplies all the quarry's compressed-air needs. It runs at 200 rpm and discharges at 100-psi pressure.

About 60 percent of the fine mill is driven by steam engine; all other machinery is operated electrically. This is a completely dry plant, but dust is kept at a low point by Sly dust collectors and also by means of a chemical fog supplied by Johnson-Marsh.

The Brewster contract called for five sizes of stone ranging from ⅜ inch to 2½ inches, in addition to some dust, which was used for top curing the asphalt pavement. Brewster's trucks transported some of the stone to the asphalt mixing plant and the remainder to stockpiles along the turnpike right-of-way from which it was taken as needed to prepare the subbase. A Brewster service truck carrying tires, lubricants and spare parts for the company fleet patrolled the haulage routes. Another patrolling truck was equipped with a magnet to pick up nails and other tramp iron that caused tire failure.

John H. Schmidt is president of the North Jersey Quarry Company, which has its headquarters in Morristown. Walter L. Henderson is superintendent of the Chimney Rock unit. William J. Brewster is president of George M. Brewster & Son, Inc.

# Making a Mold for Tire Vulcanization



INFINITE care is taken in fashioning the steel molds in which automobile tires are held while being vulcanized. The mold gives the tire its permanent form and also imparts to it the tread design and other markings. The molds are in two halves which are locked together, with the casing inside, and are then sent to the vulcanizers. There high heat does the work that makes the tire serviceable.

The pictures show successive steps in producing half a mold at the plant of The B.F. Goodrich Company in Akron, Ohio.

1– The mold is "roughed out" on a boring mill by Louis J. Toth.

2– The tread design is cut by John Saylor.

3– Contours of the tread design are further shaped with a pneumatic chipping hammer.

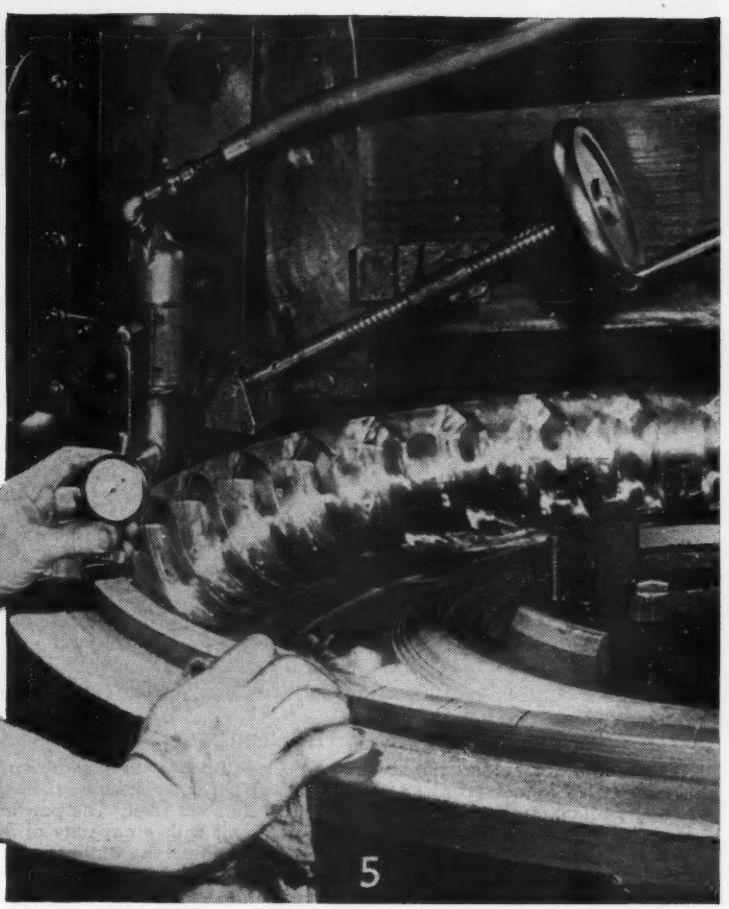
4– Phillip Carracher smooths the surfaces with a miniature grinder spun at high speed by compressed air.

5– A vent in the mold is checked to see if it is of the correct depth. Vents are necessary to relieve the air pressure built up inside the mold during vulcanization.

3

4

2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# Powder Cutting of Metals

## New Technique That Accelerates Oxidation Makes Use of Compressed Air

**Allen S. Park**

WHEN ordinary iron or steel is cut with an oxygen flame, the chemical reaction that takes place is one of oxidation. The oxygen unites with the metal to form iron oxides that have relatively low melting points and are blown away by the jet of oxygen. Cutting consequently proceeds at a rapid rate.

Stainless steel, however, cannot be cut readily in this way because the chromium it contains resists oxidation. Oxidation will start but will not proceed progressively. Instead, a refractory chromium oxide that prevents further oxidation is formed. But it has been found that this oxide deposit can be fluxed and removed by adding powdered iron to the oxygen flame. The resulting technique is called powder cutting. The first experiments along this line, which were conducted in the early part of the late war period, were made with powdered ferromanganese, but it was soon discovered that plain iron powder was superior to the combination with manganese.

**CUTTING STEEL-MILL WASTE**

Setup for reducing slag ladle buttons, spills and off-heat ingots to suitable sizes for charging furnaces. The gantry arrangement permits the Oxweld cutting apparatus to operate anywhere in the pit, while a crane can deposit or remove material without disturbing the cutter. Powder cutting has made it possible to reclaim thousands of tons of this type of scrap that could not be economically handled by any other method known.

Powder cutting is now used on stainless steel in producing mills to reclaim and prepare heavy melting scrap, to remove hot tops from ingots, to cut blooms, billets and similar pieces to proper sizes and shapes, and to scarf or rid blooms and billets of surface flaws. Stainless-steel fabricators employ it to cut plates and sheets to wanted sizes and to prepare plates for welding. It serves in foundries for removing gates and risers from castings, for cutting out defects preparatory to repair welding, and for cleaning and smoothing sand-encrusted surfaces.

**CUTTING CIRCLES**

An Oxweld machine-guided blowpipe equipped with powder-cutting attachments and connected to an Oxweld shape-cutting machine is shown here cutting 14-inch circles from stacked sheets of stainless steel. The powder dispenser, at the left, holds 200 pounds. A smaller unit with a capacity of 30 pounds is available for use in small shops or for work where the cutting equipment must be moved periodically. Either machine operates from a regular plant air-distribution line.

The apparatus utilized consists of a cutting blowpipe with facilities for supplying oxygen and a fuel gas, and of a powder dispensing system which may be of the pneumatic or vibratory type. Both use compressed air in their operation. In either case, the powder is placed in a hopper under air pressure and is discharged from it by the air through flexible tubing. The pneumatic type feeds the powder directly to the blowpipe, where it is projected into the reaction zone through a nozzle. It is the less costly of the two and is adequate for most cutting jobs.

Where it is desirable to control the flow of the powder with precision, the vibratory system is utilized. By it the powder is delivered from the supply hopper to a rapidly vibrating trough that feeds it at a controlled rate into an air stream which carries it, as before, by hose line to the blowpipe.

In both cases the nozzle that introduces the powder to the reaction zone may be attached to or incorporated in the blowpipe. The latter type is generally employed for scarfing purposes. Special blowpipes have been designed

**100-TON BLOCK**

Four powder cuts, each approximately 8 feet long and 43 inches deep, were made in order to scrap this cast-iron machine base.

for service where large quantities of powder are used such as in cutting casting risers, but standard oxygen-cutting equipment suffices for most applications.

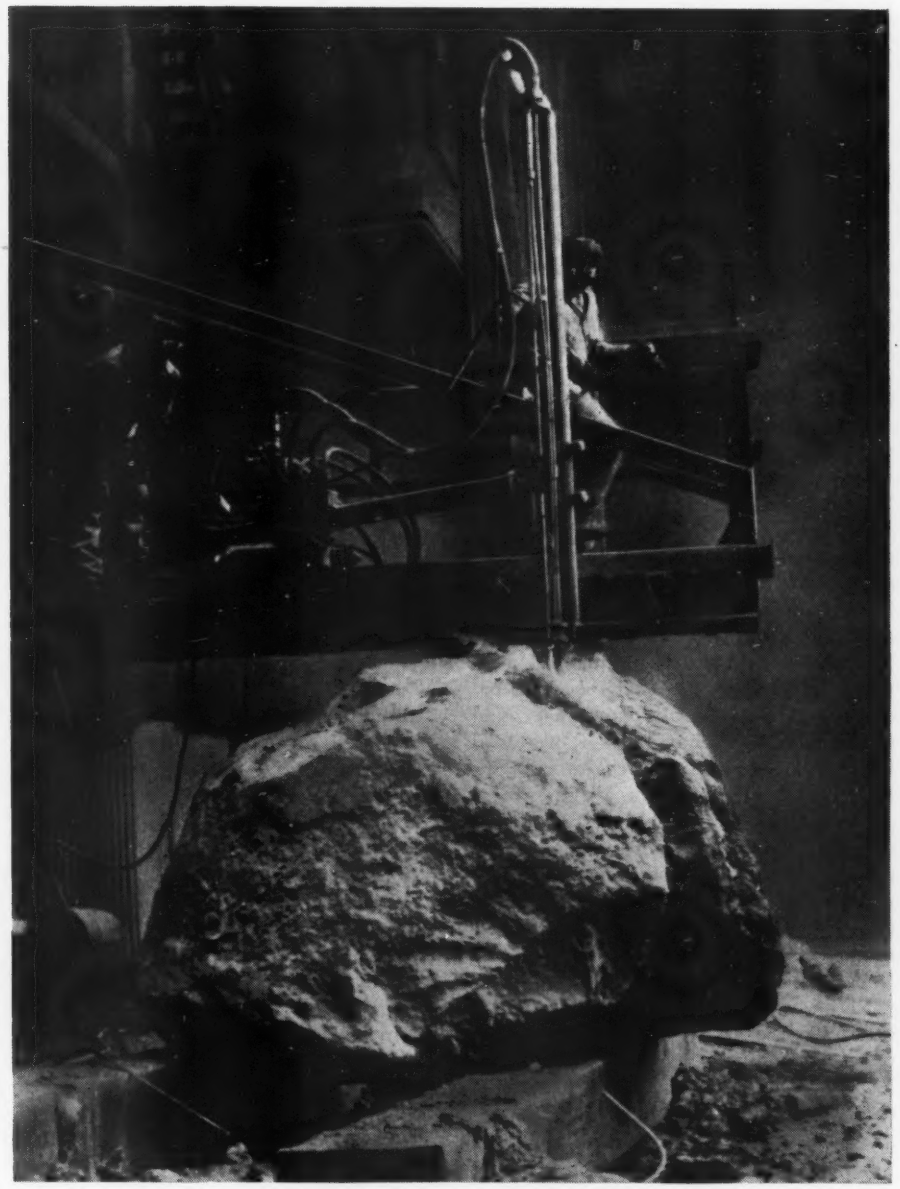
The volume of oxygen supplied to the tool must be higher than that required normally in order to oxidize the powder and at the same time maintain the cutting action. This is taken care of either by increasing the pressure of the oxygen or using a nozzle one size larger than that which would be chosen for cutting carbon steel of the same thickness. The amount of powder needed depends on the metal's resistance to oxidation and the thickness or depth of the cut. A flow of about 15 pounds per hour suffices for ordinary gauges of stainless steel, but as much as 100 pounds is sometimes used for very heavy cuts. The requirement is readily determined by experiment, and the correct rate of flow may be maintained by regulating the air pressure.

In cutting stainless steel the iron powder performs two functions: first, its exothermic reaction with the oxygen keeps the chromium oxide fluid, and, second, the molten iron oxide fluxes the chromium so that it may be blown away over and over again to expose a fresh, unoxidized surface to the action of the oxygen stream. Thus continuous reaction takes place.

While powder cutting was first applied to stainless steel, and that is still its greatest field, it has also effectively accelerated the rate of cutting mild steel and cast iron and is even used to some extent on such nonferrous metals as copper, brass, nickel, bronze, aluminum, magnesium, and the alloys Hastelloy, Inconel, and Monel. Nonmetallic refractories like concrete and firebrick likewise have been cut successfully.

In cutting ordinary carbon steel with the oxygen flame alone it is necessary first to heat the area concerned, and in the case of some sections such as round bars that is hard to do and time-consuming. If a little iron powder is added, however, a so-called flying start can be made, after which the flow of powder is cut off. In some instances as little as one ounce of powder is consumed.

The new technique is being utilized in steel mills for reducing heavy scrap such as furnace and ladle residues that are too large for charging open hearths and that contain slag inclusions which render them difficult to cut by conventional methods. In industrial salvage operations it is lowering the cost of cutting up big pieces of equipment for removal from buildings. A large cast-iron flywheel was recently dismembered in this way at less cost and in less time than the work could possibly have been done by any other means. Six cuts were made in the 15x18-inch rim with a hand torch in twenty minutes each, average time, and the 14x8-inch spokes were severed in about six minutes each.



**SPLITTING A LADLE BUTTON**

The rig pictured here is cutting a ladle button having a maximum thickness of 60 inches.

# Candles for Christmas

## Most Yule Trees Are Now Adorned With Electric Bulbs, But Churches Stick to Wax Lights

**DIPPED CANDLES**

Though ordinary candles are mass produced by machines, tapered ones are dipped in much the same manner our great-grandmothers did it, but on a larger scale. Starting with wicks strung on "bird-cage" forms, the candles are built up in layers by repeated dipping (top-left). To dry them, they are hung from the ceiling, where they look like elaborate candelabra.

DESPITE the replacement of candles by electric bulbs on Yule trees for safety reasons, they are still associated with Christmas by the older generation. Once relied upon for light in much of the world, candles now mainly serve decorative and religious purposes and are made in many shapes and sizes. There are miniature Santas and snowmen for Christmas, tall tapers for floral centerpieces at dinners and banquets, and tiny candles for birthday cakes.

Once a household chore involving the use of beef suet, cheesecloth and crude molds, candlemaking has become big business. Each year Americans spend more than $13,000,000 for a quarter of a billion candles, few of which are consumed for the reason our forefathers burned theirs. Today, paraffin and stearin are the major ingredients of candles, but those used for religious purposes usually are more than half beeswax because of an early but now disproved Christian belief that it was produced by virgin bees and was therefore symbolic of the purity of the Virgin Mary.

Candles were probably first made by soaking the pith of rushes in household grease. This method was improved upon when wicks of flax and cotton threads were introduced. The wax candle is believed to have originated in Phoenicia and that of tallow came later, perhaps around the second century. Candlesticks also appeared early, but were not a household commodity until the Middle Ages. Moses was commanded to make a 7-candle holder for the tabernacle. After the destruction of Jerusalem by Titus it was carried to Rome with other spoils. Solomon put ten candlesticks of gold in the temple, five on each side of the Holy Place. Coming down to modern times, 1000 candles set in chandeliers lighted the first White House in 1809.

It has long been an Irish custom to place candles in windows on Christmas Eve to guide the Christ Child on the long journey from heaven. And every Candlemas Day (February 2), which is celebrated in commemoration of the presentation of Christ in the Temple, Catholic churches throughout the world consecrate the candles that are to be burned during the coming year. This practice began in the eleventh century.

"Candle auctions" are still occasionally held in England and date back to 1698 when William III officially prescribed that method for selling goods imported from the East Indies. By it, an inch of candle is lighted, and the person making the last bid before the flame dies is ruled the purchaser.

The waking and working day formerly extended from dawn to dusk and was gradually lengthened as crude lighting facilities became available. In this country the Indians burned pine knots, and early settlers adopted the practice. Then they began to use candlewood or "fat wood" which was taken from the heart of the pine. It was cut into slender pieces about 8 inches long, and these were tied in bundles and seasoned.

The pilgrims brought candlemaking equipment with them from overseas, but suet or tallow was scarce until domestic animals became numerous. In New England, bayberries, the fruit of the wax myrtle, were boiled to obtain their wax content. Of attractive green color, it burns with a fragrant odor, and candles made from it do not melt in summer and are not greasy to the touch. Consequently, they were much used, especially on Cape Cod, and may be purchased even today.

Bear and deer suet went into many early candles, to be followed by spermaceti, the waxy solid from the head of the sperm whale. In later years beef suet was principally used for the purpose. For most of the pioneer women, fall was candlemaking time. They generally produced the year's supply then, because a housekeeper was considered to be "shiftless" if she made candles only as they were needed. The work

was done in front of the fireplace, where the suet was "tried out" or refined in a huge kettle hung on a crane over the fire.

In the beginning, dipped candles predominated. To make them, wicking was first wound around a board, about 9 inches wide, and then cut along one edge to make strands 9 inches long when doubled. The material was usually cotton, often spun in the home. The pieces were hung, approximately 2½ inches apart, over a round wooden rod about 18 inches long and ¼ inch in diameter. Each was twisted, and while it was held with one hand the fingers of the other were dipped in fluid tallow and rubbed on the wick to keep it straight and firm.

Melted tallow that had been strained through cheesecloth was next poured into a kettle of hot water, enough being used to form a layer approximately 1½ inches thick on top. Into this the wicks were lowered until they touched bottom. Repeated immersion, with time allowed in between for setting, built up the tallow to a thickness of around ¾ inch at the base. After that the candles were scraped to remove irregularities and hung on hooks in the cellar for four or five days to harden and cure. Unless that was done they would melt and bend out of shape.

Molded candles were produced in tapered forms or tubes, generally of tin, from 9 to 10½ inches long and about ⅞ inch in diameter at the large end. The latter was open while the other end was closed except for a small hole in the center. The molds were fastened together in clusters of 2 to 48, with twelve the most popular number. While the tallow was melting, wicks were cut to lengths of approximately 15 inches. By aid of a wire, one end of which was bent into a hook, a wick was pulled through a tube and out through the hole in the small end, where it was knotted to prevent it from sliding back. Sometimes a wick was drawn down through one mold and led back up through the adjacent one, in which case no knot was required.

After all the wicks were in place, the end that protruded from the open end of each mold was divided and tied around a small wooden peg or meat skewer extending across the tube to keep the wick centered while the tallow was being poured. With a tin cup or dipper, the molds were filled and then set in a cool place for fifteen minutes or longer. After the tallow had hardened, the knots at the closed ends were cut so that the candles could be withdrawn. To loosen them, the forms were thrust briefly into warm water, after which the candles were removed by lifting the skewers. The wicks were next cut off flush with the large ends and the candles hung to cure.

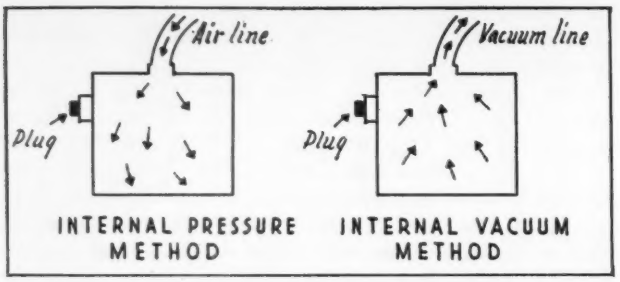
Candlemakers, called chandlers, plied their trade in Europe as early as the thirteenth century and also came to this country. At first they worked on the customer's premises, using the suet the housewife had saved; later they had their own shops and sold their product. In 1769, "dipt tallow candles" were four shillings and nine pence per pound.

A candle-molding machine was invented in 1834 by a man named Morgan. Today's models, which feed wicking continuously, cast from 80 to 512 candles at a time. They are formed tip or small end down to facilitate ejection upward. The molds are cooled by circulating cold water. Paraffin wax was introduced in 1854 and has been the leading candle material ever since. Stearin, usually in the amount of 5 to 10 percent, is added as a stiffener and to reduce transparency.

The accompanying pictures were taken at the Kearny, N. J., factory of Koppers Company, Inc., which produces candles that are sold under the trade names of Master Craft and Aristocrat.

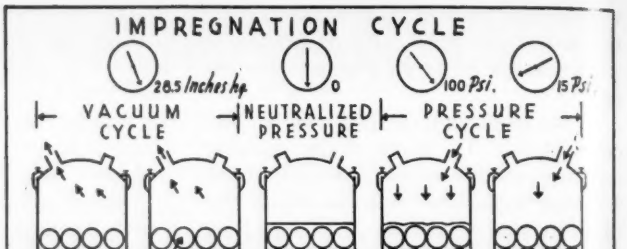
**MULTIPLE MOLDS**

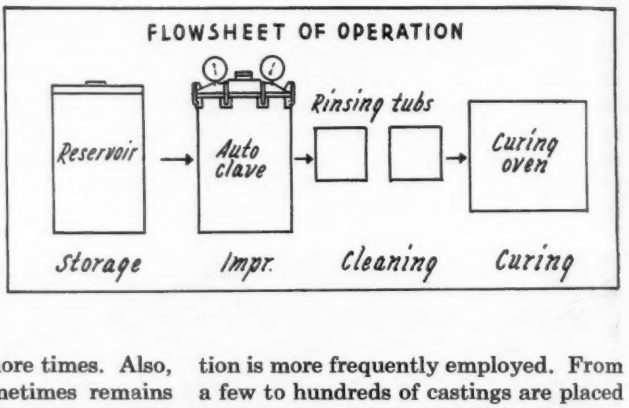
Short, stocky votive candles, which burn for fifteen hours, are used by the hundreds of thousands in Catholic churches and homes. In the Koppers plant they come from molds like the one shown at the right. There are holes in the forms for the insertion of wicks. In making common household candles, miles of wicks are automatically fed into molding machines from spindles underneath them (above). When the candles are nearly hard, plungers push them up out of the molds into racks where they remain until the setting process is completed.




**HOW SEALANT IS APPLIED**

The sketch above illustrates the process by which individual castings are impregnated by means of either air pressure or vacuum. A newer and more widely used method of treating a large number of castings in an autoclave by a combination of vacuum and air pressure is outlined at the upper right. The third sketch shows the sequence of operations making up the complete impregnation cycle.




# Porous Castings Impregnated by Pressure and Vacuum

MANY metal castings that must be pressure tight to serve the purposes for which they are intended are partially porous as cast. Formerly, such castings were rejected and new ones made, but it is now possible, in many instances, to salvage them by impregnation with a sealant.

Old-timers in the foundry industry can recall when porous iron castings were set outdoors and subjected to the elements for a long period. The theory was that the rust that formed would fill the minute openings. Probably it did to some extent, but it is doubtful if the castings stood up long, even under the relatively low-pressure services they then had to meet.

It was discovered later that sodium silicate or "water glass" would plug up the pores, but the solubility of the substance in various liquids limited its field of use. Tung oil was next tried but was only partially effective, and its application called for objectionably high temperatures. Someone then introduced a mixture of water glass and powdered metals, and compounds of this kind are still available under different trade names.

With the growing use of low-density metals such as aluminum and magnesium, better impregnants were found. They are phenolic and styrene resins mixed with linseed or castor oil for thorough penetration of casting walls. They too have limitations, which are attributable mainly to their volatile constituents. These sometimes "bleed out" during curing operations and necessitate repeating the process one or more times. Also, a brownish residue sometimes remains and must be removed from the casting before it is used.

A new sealant recently developed by Western Sealant Inc., of Culver City, Calif., and called P.E. No. 1 is a thermosetting copolymer that can, it is claimed, withstand extreme pressures and temperatures and does not react with industrial liquids and gases. According to the company's president, M. Jordan Nathason, it can be quickly and economically applied to both ferrous and nonferrous metals and, because it is made up entirely of solids, has a long-lasting effect. It has been approved for castings entering into military equipment, and is included in the specifications of major aircraft manufacturers. It is reported that parts treated with it show no discoloration, no change in critical tolerances or other indications of impregnation.

In order to insure good penetration, the sealant is applied to the metal with the aid of either compressed air or vacuum, or both. The general practice has been to treat castings individually. To do this, the part is cleaned and all openings but two are closed. An air line is attached to one of them and the sealant is poured in through the other, which is then plugged. Pressure is exerted until the solution oozes through the outer walls. Or, instead of using pressure, a suction line is attached to one opening left in the casting and the sealing solution applied to the outside or just to a local area that shows porosity.

Now the batch method of impregnation is more frequently employed. From a few to hundreds of castings are placed in an autoclave from which the air is exhausted until a vacuum of 28 inches of mercury is reached. This is maintained for some time. During this interval enough liquid sealant is introduced to cover the parts. Next, the vacuum is released and air at a pressure of 100 psi applied for at least 30 minutes. The pressure is then reduced to 15 psi and a valve opened, whereupon the sealant is forced out of the autoclave and into a storage reservoir. The parts are drained and removed, rinsed in a solvent and dried and cured in an oven for ten minutes at 300°F. Capillary action keeps the sealant in the pores during the rinsing operation. The amount of pressure used, the duration of its application, and the length of the curing period vary with the porosity and the wall thickness of the castings.

An outgrowth of the batch impregnating process is a method of bonding similar or dissimilar materials such as plastics, neoprene, glass, ferrous and nonferrous metals especially in such forms as sleeves, inserts, etc. The parts are brought together either manually or hydraulically, depending upon the tolerances involved, put through the regular impregnation cycle, and are then cured. The sealant penetrates the space between the contacting surfaces and forms a tough, resilient wedge. Because the binding agent is anhydrous and a good insulator, it will also prevent electrolysis where two dissimilar metals are in contact.

# This and That

**Whoosh! and It's There**

Dun & Bradstreet, New York firm that checks on everybody's credit rating, has put in an interoffice pneumatic tube system that transmits messages without encasing them in the conventional carriers. It is the first of its kind in the country and was supplied by International Standard Trading Corporation, an associate of International Telephone & Telegraph Corporation. It was developed by Mix & Genest, German subsidiary of I.T. & T.

The tubing is of rectangular instead of circular cross section and messages are written on small tickets and inserted in slots at the sending stations. At the delivery points they pop out into trays without human aid. At Dun & Bradstreet the system dispatches inquiries received by telephone to clerks in the filing section. This takes only three to seven seconds, and many queries can be answered while the customer holds the phone. Because of its speed of transmission, the system is appropriately called the "whiz tube."

★ ★ ★

**Magnetic Currency Detective**

Most foreign currencies can be bought in the United States below their prevailing home rates, and some of them are really on the bargain counter. This impels many persons living here to buy notes from dealers for mailing to friends or relatives abroad. The practice is illegal, however, and if the money is intercepted by postal authorities overseas it is confiscated. To circumvent this, bills are often mailed one or two at a time, and envelopes are consequently not bulky enough to arouse suspicion. Nevertheless, the British Government has found a way to spot even single pound notes. Embedded in each note is a thin, hairlike wire that enables it to be detected by a magnet in a machine through which all incoming mail is fed.

American dealers receive most of their foreign money from Switzerland, the world's market center. Some coins also reach them through domestic banks, which get them from travelers returned from abroad. A minor flow comes from slot-machine operators. Many persons who obtain a piece of hard foreign money don't know what to do with it so they try it in the first mechanical vending machine they encounter. The harvest from these sources consists mainly of Canadian pennies, nickels and dimes.

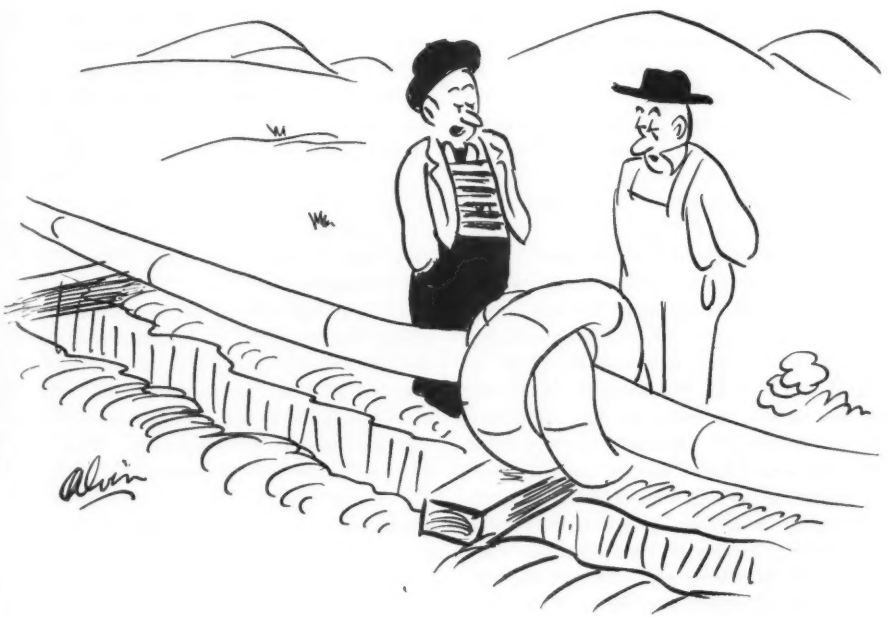
★ ★ ★

**More on Roof Bolting**

Shortly after the article *Roof Bolting* in our November issue had been made ready for printing, we noticed one by Sergei Zelenkov in the November number of *Asarco News Letter*, published by American Smelting & Refining Company, that gives additional information on this new technique of shoring up mine workings without using conventional timber props. The advantages of roof bolting have, we learn, increased coal production around 30 percent. Bolts now support some 85 million square feet of roofs in 450 coal mines that are accountable for an output of 70 million tons.

In metal mines, roof pinning has so far been practiced in only isolated instances, one of which is described by Mr. Zelenkov. In an A.S. & R. mine at Kokomo, Colo., the method was applied successfully from July 1, 1949, to January 31, 1950, at which time the property was shut down. In excess of 1000 bolts were used in five stopes, the largest of which contained 450. The hanging wall was composed of structurally weak interbedded sandstones, shales and silt stones. The bolts were of the slit-rod-and-wedge type and were made up on the property from 1-inch rods of mild steel purchased in 20-foot lengths. Bearing plates were cut in the form of equilateral triangles with 6-inch sides from ⅜-inch scrap steel plate. Complete bolts, 6⅔ feet long, cost $1.50 each and were installed under contract for $1 each. At this over-all expenditure of $2.50 per bolt, the cost of roof pinning amounted to 13.65 cents per ton of ore mined. In other stopes where timbers were set up the material alone came to four times that figure, and the cost of placing it was more than that of roof bolting.

Bolts were driven into drilled holes with a stoper rock drill, and the nuts for holding the bearing plates in position were tightened with an Ingersoll-Rand 534 impact wrench. It is estimated that 90 percent of the bolts were successful. One of them, at the edge of a cave, was pulled apart by an estimated load of 20 tons, but half of it remained firmly anchored. The production of the mine per man-shift was higher in the bolted stopes than in the others. Safety conditions were of the best, not a lost-time accident being recorded during the extraction of around 15,000 tons of ore.



"One of the welders quit this morning."

★ ★ ★

**Rammed Earth Buildings**

Seeking to help people of limited means to build homes they can afford, the Texas Engineering Station has been testing rammed-earth walls. The information thus obtained was published in the November issue of *Capper's Farmer*. It was found that soils suitable for this type of construction may contain from 50 to 90 percent sand and from 50 to 10 percent silt and clay. The most favorable mix was determined to be one containing 70-80 percent sand and 30-20 percent silt and clay. The sand gives strength and the silt and clay serve as binders. Where finances permit, a stronger material may be made by mixing 14 parts cement, 2 parts vinsol resin and 84 parts earth. Where earth alone is used, walls should be at least

14 inches thick in a 1-story structure. In a 2-story building the first-floor walls should be 18 inches thick and the upper ones 14 inches. The use of pneumatic tampers is recommended to make sure of adequate consolidation.

★ ★ ★

**Rubber from Wood**

A way of making synthetic rubber from alcohol obtained in sulphite-process paper mills has been discovered by technicians at the University of Technology in Stockholm, Sweden, according to an article in *Teknisk Tidskrift*. The new rubber, butadien, has much greater wearing resistance than natural rubber and its durability or "aging properties" are likewise said to be superior. It has been found, further, that lignin, a residue in making cellulose, is a good substitute for carbon black as a filling material and still further increases the durability of the rubber. Only about one-third of the alcohol produced by the Swedish paper industry is utilized locally, the remainder is exported for use as motor fuel. Synthetic rubber is made in Sweden also from the Russian dandelion, *taraxacum koksaghys*, but the output is reported to be small.

★ ★ ★

**New Mineral Finds in Pennsylvania**

Although Pennsylvania has in recent years ranked either first or second among the states in total mineral output, it has yielded little metal. In fact, its only important metal producer is the Cornwall iron-ore operation of Bethlehem Steel Corporation. This will soon be changed, however, for two sizable mines are being developed. Most spectacular of these is Bethlehem's venture near Morgantown in southern Berks County.

Deposits of magnetite lying from 1500 to 300 feet under the surface were discovered there about eighteen months ago by air-borne magnetometers. The find is notable because it is the first iron-ore uncovered in the United States in many years. Bethlehem is sinking two shafts and will erect a beneficiation plant to upgrade the ore to approximately 70 percent iron content. This concentrate will be sent to either the company's Steelton or Bethlehem mill. Pyrites, which are expected to be obtained as a by-product, will go to the plant at Sparrows Point, Md. The corporation is withholding detailed information, but it is reported to be preparing to employ 1250 men and has received a certificate of necessity from the Defense Minerals Administration for the accelerated amortization of an investment of $34,000,000.

At Friedensville, within 3 miles of Bethlehem, The New Jersey Zinc Company is sinking a shaft to open old zinc mines that were worked through open pits from 1853 to 1893. The mines were abandoned because of the heavy cost of pumping water and also because production was shifted to Franklin, N. J. Now the latter deposits are nearing exhaustion and the concern is getting ready to mine at Friedensville.

Also bolstering Pennsylvania's mineral output are new discoveries of natural gas. Late in 1950, Dorcie Calhoun, a farmer, and associates struck gas on Calhoun's property in Clinton County with a nondescript drilling rig. Within a year 60 wells were producing, and a field 1½x5 miles in size had been delineated. To date most of the yield has been piped to Elmira, N. Y., and vicinity by the New York State Natural Gas Corporation, but last month Columbia Gas System, Inc., put in service a new $11,000,000 pipe line extending for a distance of 167 miles to the Pittsburgh area. The Liedy Field, as it is known, is currently yielding 596 million cubic feet of gas daily.

★ ★ ★

**Blast Furnace Record**

Republic Steel Corporation's No. 5 blast furnace at Cleveland, Ohio, established a new monthly production record in September by turning out 48,005 tons of pig iron in 30 days. This was at the rate of 1600 tons a day, or 1.1 tons per minute. When constructed in 1943, its rated daily capacity was 1275 tons and its average output until 1946 was 1170 tons. In that year it was converted for operation under the high-top-pressure method of blowing originated by Julian M. Avery and patented by Arthur D. Little, Inc., of Cambridge, Mass.

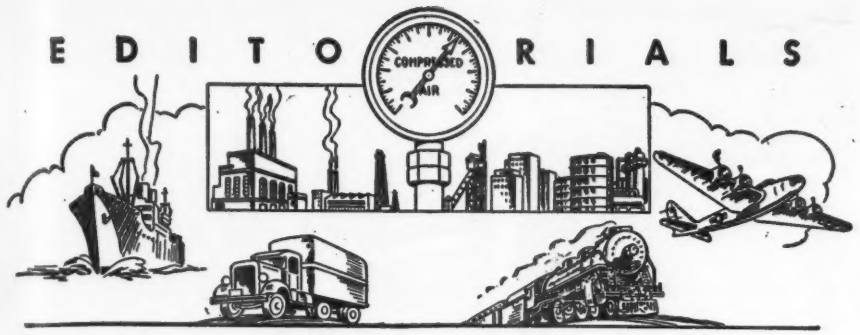
As described in our July, 1947, issue, the technique consists in increasing the pressure at the top or discharge of the furnace to 10 or 12 psi, which requires a higher than normal blast pressure at the bottom of the furnace. The reducing gas going through the furnace is then compressed to a smaller than normal volume. This makes it possible to introduce more air, which permits burning more coke and, hence, smelting more iron ore. At the same time, the velocity of the gas passing through the furnace is slowed from around 65-70 feet per second to about 45 feet and this reduces the quantity of raw materials that is blown out of the top and that has to be collected and sintered or agglomerated if reused. September was the third consecutive month No. 5 furnace exceeded its previous best performance. In setting the new mark it also established a record for "wind" blown, with a daily average of 6340 tons delivered.

**"We couldn't afford a new paint job, so we just had a slip cover made for it."**

Since the conversion of No. 5 furnace to the new method of operation, six additional Republic furnaces out of a total of 21 have been changed, and the seven top-pressure units now account for nearly half of Republic's pig-iron production. Aside from Republic, United States Steel Corporation has one furnace functioning under the new technique at Braddock, Pa., and there is one in England. However, five furnaces in this country are at present being converted, and six that are under construction will use the method. Dr. Bruce Old of Arthur D. Little estimates that, combined, they will yield a million more tons of pig iron annually than they would if operated conventionally.

Doctor Old states that between 75 and 100 blast furnaces in the United States could be changed at an average cost of from $150,000 to $200,000 each. These are furnaces that now have excess blower capacity. Top-pressure operation would augment their capacities by about 10 percent, which would mean an increase of 3-4 percent in the national pig-iron output of 72 million tons a year. This could be accomplished at an outlay of approximately 20 million dollars, which is little more than the cost of one new large furnace and its accessories.

By adding to the blower capacity it would be possible to convert as many more furnaces, and that would add 9-12 percent (6.5 to 8.6 million tons) to the annual pig-iron producing capacity without new furnace construction. Machines designed expressly for top-pressure blowing are powerful. Two Ingersoll-Rand units recently built for Republic Steel are each rated at 125,000 cfm at a discharge pressure of 40 psi. One is in service in Cleveland and the other in Warren, Ohio. Each is driven by a 17,250-hp steam turbine.




## SYNTHETIC FUELS

EACH year we move closer to the time when we will produce some of our oil and gasoline synthetically. Two possible sources are being investigated: oil shale and the hydrogenation of coal. There is no doubt that either one can provide acceptable grades of fuel for diversified purposes. The only unsettled question of importance is whether these products can, under available processes, be turned out at a cost that will permit them to compete with those derived from petroleum.

A day will come, of course, when there will no longer be enough crude oil to go around, and it is in anticipation of that time that current investigations are being conducted. Nobody can foretell with even a reasonable degree of accuracy when we shall reach that stage. Even the experts have erred in their predictions. The sharp rise in the consumption of petroleum products during World War I aroused fears that our known oil reserves would soon be exhausted and stimulated interest in oil shales, which occur by the billions of tons in Colorado, Utah and other western states.

It was then freely forecast that within ten or twenty years we would be short of petroleum, and the Government was urged to lose no time in developing practical methods of mining shale and extracting and refining its oil content. An experimental station was established at Rifle, Colo., and considerable work done, but hardly enough to reach definite conclusions.

Those who predicted an early shortage of petroleum failed to reckon with the potentialities of the then new science of geophysics. Using scientific tools that locate earth structures favorable to the retention of petroleum with all the uncanny accuracy claimed by dowsers, a new and continually increasing force of geologists began to discover oil at a faster rate than it was being used. The East Texas Field alone was sufficiently prolific to meet a goodly percentage of our requirements, and it was only one of many detected. Since that time geophysicists have been turning up additional sizable deposits, the latest, in west Texas, being as yet undefined but obviously extensive enough to place it among the best the world has seen.

Meanwhile our consumption of oil and gasoline has gone up rapidly, and with petroleum one of the recognized prime war materials, misgivings about our future supply have again arisen. For several years past technologists of the U. S. Bureau of Mines have been busy once more at Rifle and have devised shale-mining methods and oil-extraction processes that give promise of yielding final products at costs comparable to those at which petroleum is now produced and refined.

Oil companies are not getting excited about these developments, however. For one thing, they are not going to turn from familiar practices and make big investments in new equipment so long as sufficient petroleum is coming from the ground, or at least so long as geologists continue to find new sources of supply faster than those now being worked are being depleted. For another thing, the large oil companies have owned the bulk of the shale deposits for a good many years, so they know that they will be available when the time of need really comes.

With regard to the hydrogenation of coal, the picture is not so clear. The Germans worked out basic hydrogenation processes during World War II and made considerable gasoline from coal. They did it, however, not by choice but from necessity, since petroleum was in short supply with them.

Oscar L. Chapman, Secretary of the Interior, believes our Government should set up large-scale coal-hydrogenation facilities right away rather than wait until they are needed. More than a year ago he asked the National Petroleum Council to report, among other things, on the probable expense of producing synthetic fuels by this method. Its finding, made public on October 31, was that gasoline obtained in this manner would cost from 41.4 to 43.5 cents a gallon, as compared to current refinery quotations of from 12 to 13.625 cents, depending upon the grade. These figures were based on an estimated outlay of $533,000,000 for a single plant of 25,880 barrels daily capacity or $4,074,000,000 for eight plants of 216,000 barrels daily output. The investment per barrel, daily capacity, would amount to $20,600 in the first instance and to $18,900 in the second.

Secretary Chapman is not satisfied with the report, however, and contends that the costs cited are far too high. He has indicated that he will continue to urge that hydrogenation plants be set up and operated. Oil-industry leaders consider his action a little premature. They say that when the time is ripe, normal incentive itself will motivate established companies to provide synthetic fuels. Meanwhile, they are of the opinion that nothing should be done that would artificially stimulate the growth of a synthetic-petroleum program.

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## MIGHTY MECHANIZATION

IN OUR country human muscles now produce only about one-sixteenth as much as machines and tools, according to Roger F. Waindle, vice-president of the American Society of Tool Engineers. He attributes 94 percent of all our productivity to mechanisms and only 6 percent to energy supplied by man himself.

If all the 62 million employed persons in the United States were unaided by machinery, their combined annual effort would amount to 124 billion man-hours of work. Actually, however, because of the great help they receive from machines, our potential productivity, as estimated by Mr. Waindle, equals 1½ trillion man-hours. In other words, mechanization has multiplied man's efforts by eleven.

This power to produce is held responsible for the position of world leadership North America has attained and to portend its continued preëminence. To cite one example: the United States manufactures 76 percent of all automobiles and owns and operates substantially the same proportion of those cars.

"If you have the capacity to produce," Mr. Waindle asserts, "and you use that capacity effectively, you will always wind up with something closely in proportion to that capacity. That applies not only to automobiles but also to wheat and corn, clothing and shoes, gasoline and fuel oil, airplanes and tanks, guns and ships and radar equipment—in short to anything for the production of which machines and tools are used to boost man's efforts."

Mr. Waindle thinks Russia hopes to keep us from becoming fully engaged in production for either peace or defense. Either a complete war or a complete peace would bring about the defeat of Russia and her satellites, he contends. "A complete war would result in Russia's eventual economic exhaustion. A complete peace would bring defection from the Soviet's ranks of most of her associate nations as their standards of living increased."

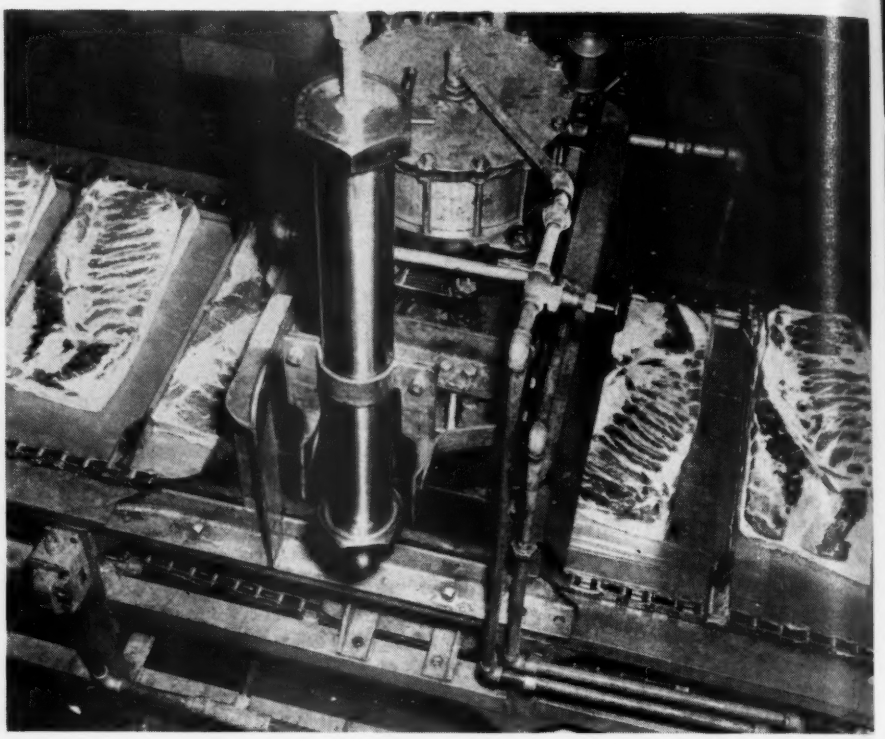
## Quick Cure for Bacon

FROM grunt to gullet in five days. By a new quick-curing process sixteen days are shaved from bacon's normal 3-week curing period. The Indianapolis, Ind., meat-packing firm of Kingan & Company developed the method, and nineteen other meat packers became licensed users of Inject-O-Cure a few months after it was made available.

Contrary to popular rule, here is an instance where the American public didn't mind having something rammed down its throat. Quick-cured bacon was marketed for about eighteen months before the process was offered to the meat-packing industry, but not until consumer acceptance was found to be highly satisfactory. According to an article on the subject in the May, 1951, issue of *Food Engineering*, experts cannot tell the difference between the quick- and the conventionally cured bacon.

Consumers want properly cured bacon, and this means uniform diffusion of the pickle throughout the tissues. It is claimed that bacon treated by the new method will not be too salty at one end while the other borders on fresh pork. The reason for this is that compressed air is used to inject the pickle through multiple needles into the bellies, jowls, squares and butts, thus distributing it evenly throughout the meat and in just the right quantity. From 24 to 48 hours in storage after injection completes the curing period.

Inject-O-Cure units of the present type are designed to handle a maximum of ten bellies a minute, giving each machine a capacity of about 200,000 pounds in a 40-hour week, depending upon the weight of the pieces. Only two operators are needed, one to load and the other to unload the conveyor, which carries the meat along continuously on the order of an assembly line. Upon reaching the delivery end, the product can be taken to storage or loaded directly into trucks or cars for shipment. Obviously, the process has much to commend it from the production standpoint, but it is also said to insure bacon of uniform quality and flavor.



**INJECTING PICKLE**

As a conveyor-borne belly stops momentarily, a pneumatic lift pushes it upward permitting 101 hypodermic needles or hollow plungers to penetrate the meat and to inject the curing solution by compressed air. The mechanism consists essentially of two 1000-pound stainless-steel castings mounted one above the other and of a large overhead air cylinder. In the lower casting are 101 holes in which the needles operate. The upper casting serves as a reservoir for the curing solution and also supports a plate to which the vertical plungers are attached. As the top casting moves downward, the plungers pass through the lower casting and into the bacon, valves open, and pressure is exerted to inject the solution. As the needles are withdrawn, the valves close and suction is created to draw fluid into the needles from the reservoir for the next cycle. The machine uses air at a pressure of 75 psi.

## Boron as an Alloying Element in Steel

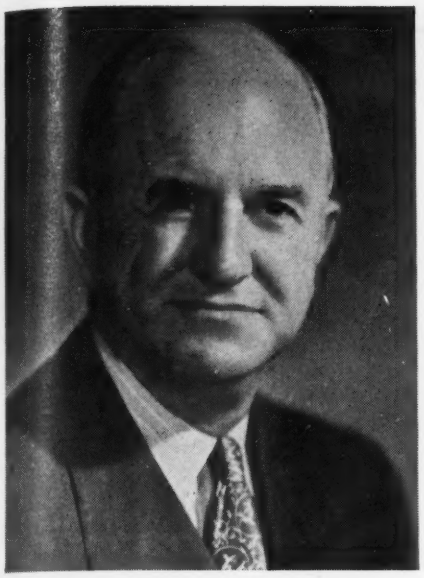
BORON may prove to be an ace in the hole that will help pull the United States through a critical shortage of some alloying materials used in making steel, according to the National Production Authority of the U. S. Department of Commerce. Unlike other alloying agents, most of which are imported, the sources of boron are close at hand and abundant. It is extracted from borax, which is plentiful in the desert areas of the Southwest.

A relative newcomer in the list of alloys, which are used to make steel hard and resistant to heat under heavy loads as well as to corrosion, boron's principal characteristic is its capacity to harden and toughen steel to withstand strains. Certain forms of it can also resist very high temperatures, but because they have a brittle quality it is doubtful whether they can stand up under temperature and strain combined.

America's acquaintance with boron steel began in 1921, when a German concern applied for a United States patent. But not until World War II did it graduate from the laboratories to the furnaces of steel plants. During that period the metal was used largely for making armor plate. In the meantime, metallurgical processes for producing steels of this type have undergone further refinements.

The manufacture of ferroboron, the alloying element in steel, is a complex procedure. First, borax is treated with sulphuric acid to obtain boric acid, which is then fused with iron in an electric furnace. The resultant product is diluted further with aluminum, titanium and other materials to make what is known as an "addition agent." Through extensive experiments it has been found that extremely small amounts of ferroboron in steel melts—sometimes as little as 0.003 percent—will yield a product of sufficient hardness to meet exacting military and industrial standards and that will at the same time drastically reduce the amounts of chrome, molybdenum, vanadium and nickel ordinarily required in the manufacture of alloy steel.

Numerous American industrial concerns have already used boron-treated steel with success in making shafts, gears, bearings, machine tools, tractors and axles and are experimenting with it in other directions. Until now, its production has been relatively small, but the demand for it is on the increase and the output for September reached about 25,000 tons. There are enough facilities in the United States to turn out approximately 10,000,000 tons, and the supply of the raw material—borax—is virtually limitless. The only factors that might stand in the way of comparatively large-scale output are electric-furnace capacity and availability of sulphuric acid.



STEPHEN D. BECHTEL

## Moles to Honor Two Construction Men

ANNUAL awards by The Moles, New York organization of men engaged in tunneling and heavy construction, will be made next February to Stephen D. Bechtel of San Francisco, Calif., and Charles B. Spencer of New York City for outstanding contributions to their fields of activity. Mr. Bechtel will receive recognition as a nonmember and Mr. Spencer as a member.

Mr. Bechtel is president of The Bechtel Corporation that handles construction jobs the world over. His association with it began as a summertime employee when it was called the W. A. Bechtel Company and was headed by his father. The younger Bechtel served overseas with the U. S. Army Engineers in World War I and was graduated in civil engineering from the University of California in 1923. His firm was a member of Six Companies Inc., builder of Hoover Dam, and he was a member of the executive committee.

As a unit of Bridge Builders, Inc., the Bechtel concern also constructed piers for the San Francisco Bay Bridge. As a part of Pacific Naval Air Base Constructors, it participated in defense projects prior to World War II on Wake, Guam, Midway, and the Johnston and Hawaiian islands.

During the period, The Bechtel Corporation built industrial plants, air bases and petroleum refineries and also a section of the "Big Inch" oil and gasoline pipe line extending from Texas to the eastern seaboard. It constructed military bases in Arabia and, as a partner in Bechtel-McCone, helped lay the Canol Pipeline in Canada. Other wartime activities included association with Marinship Corporation and California Shipbuilding Corporation in the building of ocean-going vessels. Since the war the firm has laid several sections of pipe line for the oil industry in this country and is now engaged in similar work in Arabia.

Affiliated Bechtel organizations are: Bechtel Constructors, Bechtel International Corporation, International Bechtel, Inc., and Compania Bechtel, S. A.

Mr. Spencer is president of the New York engineering and contracting firm of Spencer, White & Prentis, which specializes in the field of heavy and unusual foundations for structures. He was born in New York City, attended public schools there and entered Columbia University in 1903. He received two degrees, acquired keys from two collegiate honorary societies, and played on championship basketball and soccer teams. His graduation thesis, *Strength of Metals Under High Temperatures*, was so well received by the growing automobile industry that it was published and widely circulated.

Prior to World War I, Mr. Spencer worked at many jobs including railroading, tunneling, architecture and, finally, foundations and underpinning. After he had entered the Army his departure for France was delayed by a special leave so that he might inspect and report on the settlement of the Cotton Exchange building in New Orleans, La.

Upon returning from European war service, Mr. Spencer, together with Lazarus White and E. A. Prentis, organized the firm he now heads. In its 32 years of existence it has handled upwards of 1000 contracts in various parts of the world. These have included harbor work in Iran, construction of airports in the Bahamas, a bridge in Cuba, dry docks, tunnels, four sections of the New York subway system, 100 tankships in Mobile, Ala., locks and dams on the Mississippi River, and foundation and underpinning contracts in many places. Among recent activities was the underpinning of the White House. Mr. Spencer served two terms as president of the General Contractors Association, during which time he helped revise the New York City Building Code, a job he had previously worked on twice, in 1916 and again in 1936.

CHARLES B. SPENCER

An outstanding job that he likes to talk about was the erection of a 70-story building at 40 Wall Street in New York City. When tenants in a 13-floor structure on the site refused to get out until legally evicted, foundations for the new building were sunk under the old one. Mr. Spencer has been a prolific writer for construction trade magazines and has found time during a busy life to become a good golfer, having won the championship of the General Contractors Association in 1938.

Messrs. Bechtel and Spencer will receive their honors at The Moles Award Dinner on February 6. The committee that chose the award recipients was headed by George Ferris, vice-president and general manager of Raymond Concrete Pile Company.

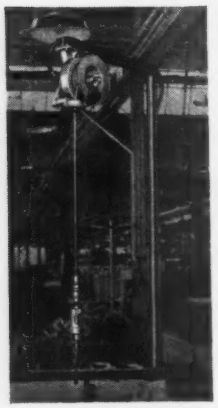
## World's Longest Power Cable

A SUBMARINE cable of such proportions that it required a nine gondola-car train to carry it is now delivering 27,000 hp of electric energy generated on the Columbia River at Bonneville Dam to two islands in Puget Sound. Manufactured by the Okonite Company, of Passaic, N. J., it is nearly 7½ miles long, has a diameter of 4⅝ inches and weighs 372 tons, or nineteen pounds a foot. To prevent breakage of the huge transmission line in transit, the couplings of the cars were both welded and chained together.

Three years of designing and planning preceded the actual making and testing of the power cable, which was accomplished in a period of five months. Upon arrival at the West Coast it was paid out by a special barge in two sections and dropped 300 feet to the bottom of the sound. To keep it from parting during the process and to protect it against damage from rocks, the cable is armored with 52 steel wires each the thickness of a pencil. It is composed of three 61-strand copper conductors each covered with corrosion-resistant, nonmagnetic Monel tape 0.005 inch thick and is cooled by the sea water which seeps between the outer wire shell and through a padding of jute filler that was twisted together with the three conductors on what is said to be the biggest cabling machine in use. The line cost the Bonneville Power Administration about $500,000, and its service life is estimated at 50 years.

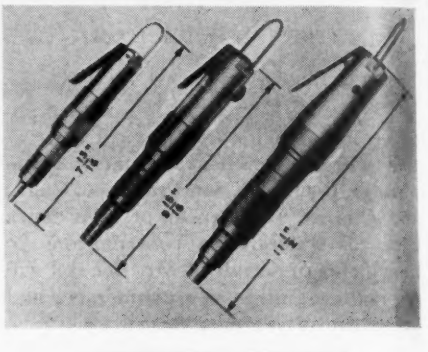
# Industrial Notes

To expedite operations on high-speed assembly lines, The Wayne Pump Company has designed a combination pneumatic-tool suspension and air-supply hose reel that excludes the use of the separate cable normally required. The tool is made fast to the pendant air hose, obviating all fatiguing lifting on the part of the operator and leaving his hands free to do his work. The weight of the tool is counterbalanced by the spring tension of the reel, and when the operator lets go of the tool it is automatically lifted to a predetermined, convenient position over the worktable. A rubber bumper stop controls the length of travel when the tool is released. Unwinding hose decreases tension; reeling hose around the spool increases tension. The unit is provided with universal mounting brackets so that it can be attached to a post, wall or hanging cable.



A copper naphthanate dip for wood that is to be immersed in water is a new member of the Fungus-Ban family made by Wilbur & Williams Company. The preservative imparts a green color to the wood as an indication that it has been treated and gives it primary protection against dry rot. Of a noncrystallizing nature, the dip permits coating the wood with ordinary or ship-bottom paint after a drying period of 24 hours.

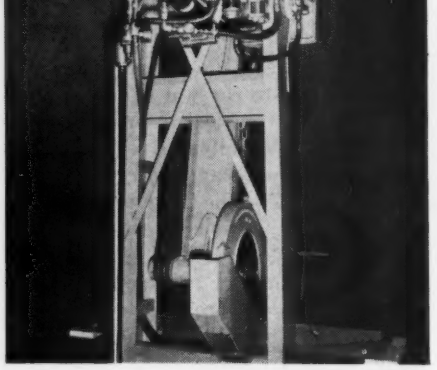
A line of air-operated screw drivers of cushion-clutch construction has recently been announced by Ingersoll-Rand Company for the automobile and aircraft industries, furniture manufacturers, metal fabricators and equipment makers generally. The cushion clutch consists of two parts: an engaging clutch that permits moving the tool from screw to screw without stopping the motor (slight forward pressure on the screw driver is necessary to rotate the bit) and a ball-type torque-limiting clutch. By means of the latter the torque setting can be changed with ease and precision so that all screws in an assembly are driven to the same degree of tightness. Torque accuracy is not dependent upon proper lubrication and is promoted by the virtual absence of the rotary impact inherent in jaw-type clutches. Another feature of the design are adjustable exhaust deflectors. The new screw drivers come in three basic sizes (there are 38 sizes for all speeds and capacities) with a wide variety of bits and finders for driving small, medium and large wood and machine screws of many kinds. Reversible and nonreversible models are made in each series, and the two larger sizes are available either with a pistol-grip handle or a straight handle which includes a bail where it is preferred to suspend the tool for operating convenience.



**AWKWARD POSITION**

**Shown here is a cushion-clutch screw driver fastening the spring mechanism to a rocking chair with No. 10 screws 1½ inches long. The wood used is alder and is not predrilled. A pistol-grip model, it weighs 2⅝ pounds and has an over-all length of 10⅝ inches. The smallest of the three basic sizes shown is made with only the straight handle.**

By drilling just four holes it is possible to install a pneumatic unit on any Heston & Anderson swing cutoff saw and thus convert it from manual to automatic operation by fingertip control. By means of the new attachment, which was developed by the company, the saw or abrasive cutter completes a cycle every time the operator moves a lever or presses a button. Distance and speed of travel can be set, as required, to cut wood, plastics or metals and to quickly return the blade to the starting position behind a guard rail, clearing the worktable for unloading and reloading. As a result, the operator can devote his entire attention to the stock, taking care of one machine when handling lumber or several when cutting metal. As it is no longer necessary to hold the material firmly with one hand and swing the saw with the other, the fatigue factor is reduced to a minimum, and it is claimed that the air operating unit has increased the production of cutoff saws from 175 to 200 percent. Some users in the lumber industry, to keep work moving, have provided their machines with conveyor aprons.



**IN A WOODWORKING PLANT**

**Left, a swing cutoff saw with the pneumatic operating unit attached. (The other picture shows a rear view of the latter with its air connections.) It is controlled by push button or lever and automatically moves the saw forward at a predetermined speed, depending upon the material to be cut. Distance of travel also is adjustable.**

Coprox is the trade name of a copperized cement coating that protects ma-

sonry and cinder blocks, clay tile, brick, concrete, asbestos shingles, etc., against dampness. It is said to form a hard surface that will not undergo chemical modifications and is free from hairline cracks. Obtainable in buff, gray, green, rose and white.

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Prefabricated panels for curtain walls and partitions are offered by Owens-Illinois Glass Company. Of sandwich construction with a core of solid incombustible calcium silicate and facings of cement-asbestos board they are said to provide better insulation than 16 inches of concrete. Designated as Kaylo Laminated Panels, they are made in lengths of 8 and 10 feet 2 inches thick and 4 feet wide.

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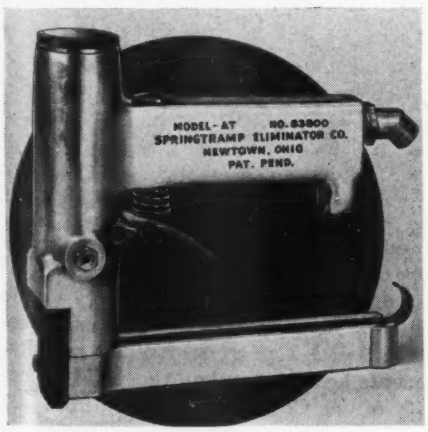
By means of the Raydist electronic measuring system, the course of an airplane, ship, or vehicle can be tracked within a foot or two. Developed by Hastings Instrument Company around 1940, Raydist was furnished only to the Government until the end of the war. In addition to its original use, it has recently been applied extensively for surveying over water or rough terrain. In 1950 it was utilized by U. S. Army Engineers in the Hampton Roads-Chesapeake Bay area to direct dredging operations. With it, certain surveys of the ship channel that ordinarily required three days were completed in four hours.

---

Compressed air does the work when stapling furniture and the like with a new impact tacker designed by Senco Products, Inc., for production-line service. Using air at a pressure of 80 to 100 psi, it exerts a force of 63 to 78 pounds in driving staples in fiber, masonite and wood, including the hardest kind. The air hose is attached by a leakproof swivel connection to the end




of the handle, where it offers least interference. A large-capacity magazine holds the staples, which are driven as fast as a trigger can be pulled. Type AT, shown in the accompanying illustration, weighs about 3 pounds and is suitable for use with either 0.03 or 0.05 pointed, blunt or chisel-shaped wire staples varying in leg length from 3/16 to 1/2 inch. Variations of the model are made to meet requirements.

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Wagner Electric Corporation, of St. Louis, Mo., has a special truck for servicing transformers in the field. Its equipment includes an air compressor that supplies air for operating the brakes and for the pressure testing of transformers. The machine may also be run as a vacuum pump for removing air bubbles and pockets from the transformer fluid, and is frequently used during drying-out operations.

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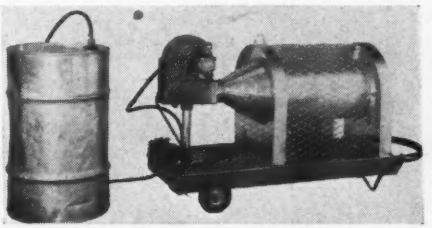
With the thought in mind that plenty of heat is often required in a hurry on construction jobs and elsewhere where none is available, Arthur C. Baumann is building a unit that is said to fill the bill. It is mounted on wheels so that it can be shifted from place to place and provided with handles and a hook so it can be carried or hoisted from one floor or level to another. Connected to any 110-volt, 60-cycle, single-phase line, it is ready for operation, and is said to produce 189,000 Btu's per hour on an hourly consumption of 1.35 gallons of No. 2 fuel oil. The latter is taken direct from the drums in which it is shipped by a hose, which can be varied in length to meet requirements. Named Eco-Temp, the new radiant heater has many applications including drying plaster, paint, concrete and other materials and surfaces; thawing frozen coal, sand and pipes; warming up equipment usually hard to start



at low temperatures; drying tobacco and other products; and space heating in cold weather to provide comfortable conditions for men working on large building projects.

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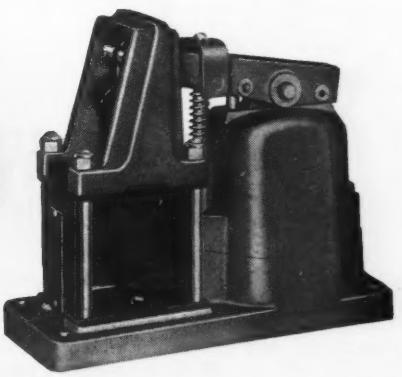
For surfaces that cannot be lettered or numbered by the usual marking methods because of hardness or danger of distortion, Funditor, Ltd., a British concern, has developed what is called a Sand-jet machine. It involves the use of a rubber stencil and the application of fine grit at short range. The machine is foot controlled and operated with compressed air ranging in pressure from 30 to 40 psi. It is equipped with an air filter, a pressure-reducing valve, and an electric timer that can be set for

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves



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● These valves are widely used for controlling single action air cylinders, clutches, etc. Can be operated with a variety of power switches, mercoid switches or automatic contact switches activated by moving objects. Stainless steel push-pull rods, brass sleeves and U-packings expanded by pressure and all enclosed against dirt, assure long, efficient, trouble-free operation. No metal to metal seating. Precision made. Individually tested. Spring or double solenoid return. 3/8" to 1 1/2" sizes: 2-way, 3-way and 4-way actions. *Write for full details.*

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# THE NIGHT BEFORE CHRISTMAS

## by Jolly Saint "VIC"

*'Twas the night before Christmas and right down the line*
*Not a drop was there leaking, even one at a time.*
*All sections were "locked" and "buttoned-up" tight*
*With Victaulic Couplings that made 'em just right.*

*All Elbows and Tees stayed right in their groove*
*For the Victaulic Method each fitting did prove.*
*With the world's best system for making ends meet*
*Each pipe and each fitting was tight in its seat.*

*Now all of this piping so good and so quick*
*Was the work of none other than jolly Saint "Vic"*
*So for better connections in the year '52*
*You'd better let "Vic" do that piping for you.*

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VICTAULIC
PIPE COUPLINGS AND FITTINGS
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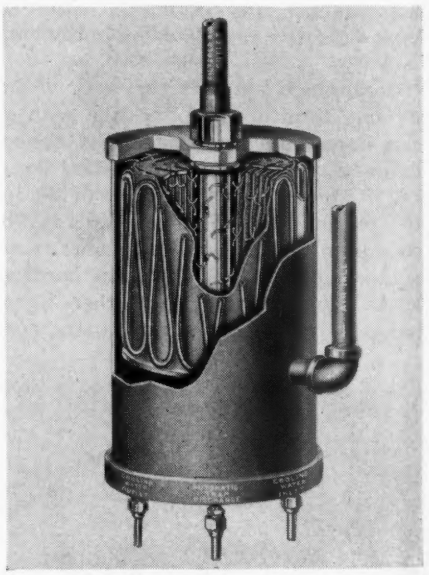
any blasting period from ½ second to ten seconds. The time can be continued, however, for as long as required by holding down the pedal. A red pilot lamp tells the operator that the Sand-jet is switched on, and a green lamp burns only during the stenciling period. It is claimed that individual masks may be used up to 3000 times and that the inscriptions are clean cut. Flat, round or concave surfaces may be marked, and special stencil holders are available for contoured parts.

---

A single compact unit, incorporating a dehydrator, a filter and a self-purging trap, has been developed by Hankison Corporation for the removal of water, oil, sludge, and other foreign matter from compressed air used for operating instruments. Designated as Model B Condensifilter, the dehydrator is composed of a series of copper coils through which cold water circulates. As the air comes in contact with the coils in its passage through this section, its temperature is reduced to within 2° of the cooling-water temperature and it is freed of moisture both entrained and in the vaporous state. The total drop in pressure across the condensing unit is said to be less than 2 psi at 100 psi working pressure. The filter is made up of five hexagonal chambers arranged in parallel



and each wrapped in seven layers of Canton flannel. Easily removed for cleaning, it provides more than 4 square feet of filtering area and retains pieces as small 1-2 microns. Where requirements are greater than the rated capacity of one Condensifilter (30 cfm at 100 psi), or where uninterrupted service is required, two may be installed in parallel permitting one to be cleaned while the other carries the load.

---

Years of experience with wire rope in handling cranes, shovels, draglines and other types of heavy equipment

are back of a combination wire-rope clamp and thimble that has much to commend it, according to the designer. It consists of two steel castings of uniform shape keyed together with replaceable standard bolts and nuts in such a way that shear on bolts is eliminated. And the heavier the load, the tighter the sections are forced together. The device is said to offer rope maximum protection, and findings of tests made by a leading wire-rope maker indicate that it permits rope to develop 85 to 90 percent of its breaking strength. Designated as the Newco Clamp and Thimble, it is a product of the Newman Manufacturing Company and is available in five rope diameters from ⅜ to ⅞ inch.

---

A Norwegian shipping line has a cargo carrier on the building ways that is a departure in the field of marine engineering. It is designed to transport ore from West Africa to that Scandinavian country and, when that trade slackens, to serve as an oil tanker. It is scheduled for delivery early in 1954.

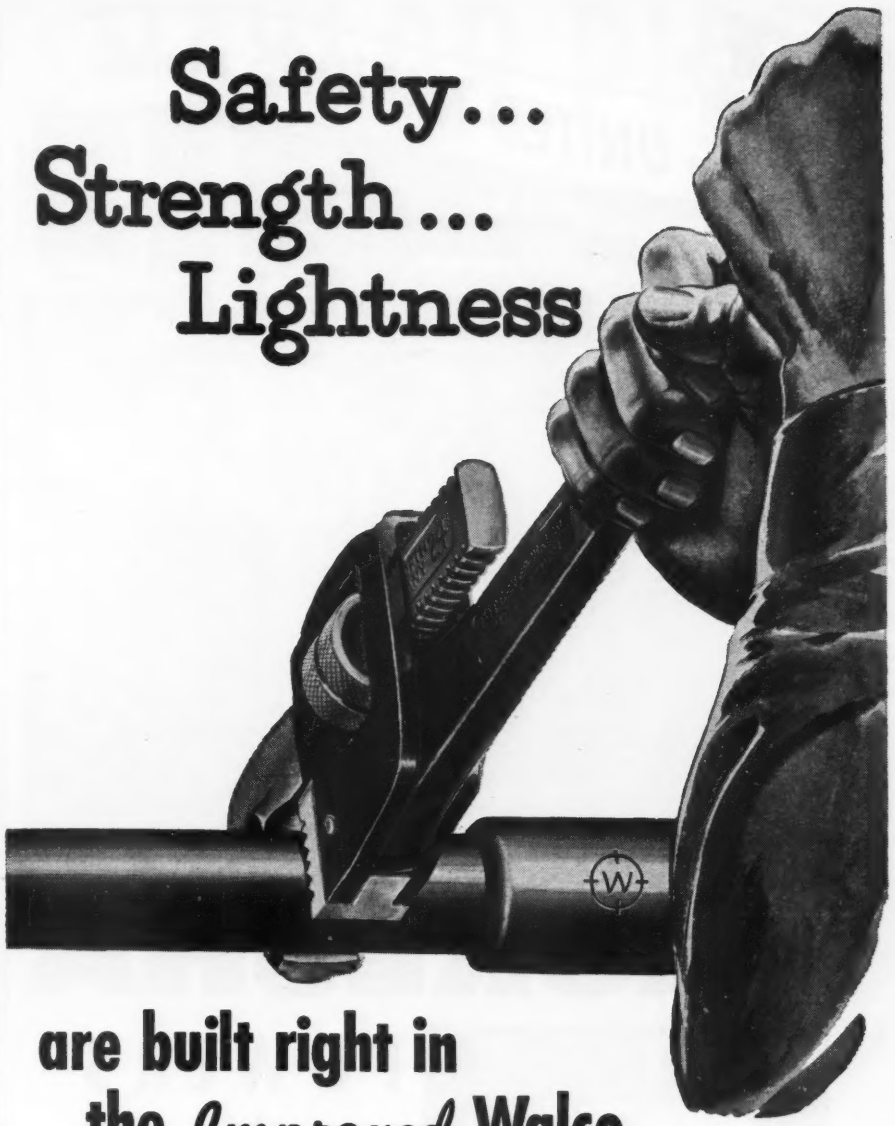
---

Screw-driving can be something of a problem in comparatively restricted places. Not so, we are told, with a new screw starter, a slender tool with a handle and a slotted head. It grips a screw firmly until it has taken hold, when a turn of the handle releases it. Made by Bonney Forge & Tool Works, it comes in lengths from 2½ to 15 inches.

---

With the slogan "Four gloves wear in every pair," Washington Glove Corporation is introducing its latest product for industrial service—gloves that can be worn on either hand. They are coated with a plastic that is said to be resistant to chemicals, abrasives, flame, oil, grease and gasoline; have a nonslip finish and a fleecy lining; and are washable. They are available in three styles: with a knit wrist and with a short or a full gauntlet.


# Safety... Strength... Lightness



## are built right in the *Improved* Walco

Walco, the strongest pipe wrench on the market today, is also the safest – and lightest all-steel wrench available. Why? Because welding – with all its inherent strength, safety and weight-reduction advantages – has been used to join the Improved Walco's housing and handle into one integral unit . . . a unit that makes the Walco so rugged that all tests show it far exceeds the requirements set up by Federal Specification GGG-651a for Type II Heavy Duty Adjustable Pipe Wrenches.

The jaws of the Improved Walco are carefully machined and will not slip; even severe abuse will not spoil the wrench's grip or quick biting action. A flexible, double-acting, quickly replaceable spring – an Improved Walco feature for which patent is pending – gives the wrench fast, positive ratcheting action. Adjustment is easy – the nut may be spun with the palm of the hand. The proper wrench opening can be determined by a calibrated pipe scale on the movable jaw.

Ask your Walworth Distributor to show you the Improved Walco – the strongest-made and longest-lived pipe wrench on the market today. Buy it – you will save money in the long run.

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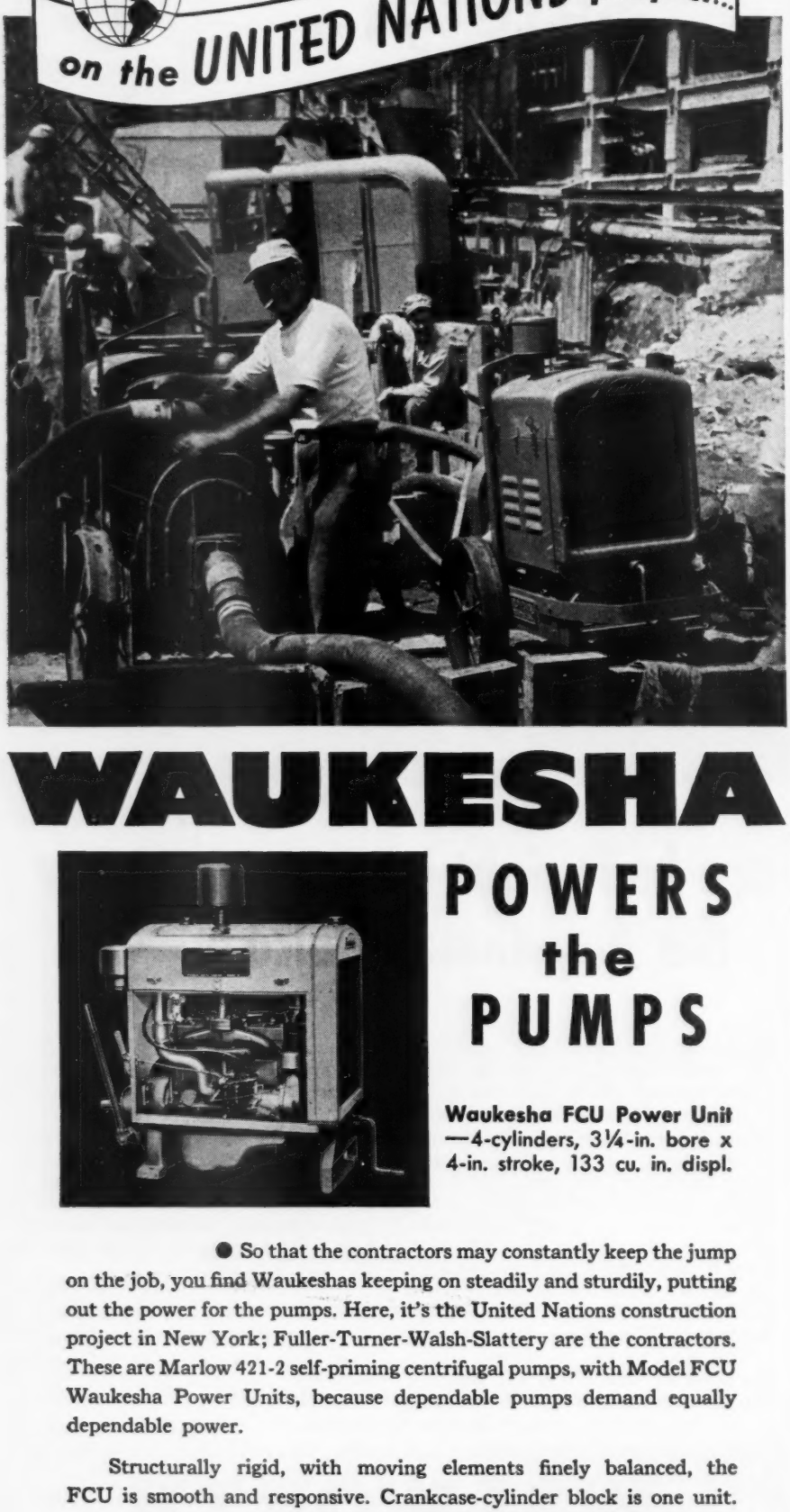


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## POWERS the PUMPS

**Waukesha FCU Power Unit —4-cylinders, 3¼-in. bore x 4-in. stroke, 133 cu. in. displ.**

● So that the contractors may constantly keep the jump on the job, you find Waukeshas keeping on steadily and sturdily, putting out the power for the pumps. Here, it's the United Nations construction project in New York; Fuller-Turner-Walsh-Slattery are the contractors. These are Marlow 421-2 self-priming centrifugal pumps, with Model FCU Waukesha Power Units, because dependable pumps demand equally dependable power.

Structurally rigid, with moving elements finely balanced, the FCU is smooth and responsive. Crankcase-cylinder block is one unit. Drop-forged extra large crankshaft has three 2⅛-in. bearings. Pressure oiled, pump-cooled, has built-in centrifugal governor; controlled turbulence combustion for extra power on less fuel. Send for Bulletin 1498.

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## Books and Industrial Literature

*Metallizing Handbook* is the result of nearly twenty years of experience in the design, manufacture and use of metallizing equipment. Offered as a guide to those engaged in the work, the text is profusely illustrated with pictures, diagrams and charts and covers the technical as well as the practical aspects of the process. A 250-page cloth-bound book, it is published by Metallizing Engineering Company, Inc., 38-14 Thirtieth Street, Long Island City 1, N. Y. Price, $3 postpaid in the United States and Great Britain.

A new catalogue covering the Sheffield line of precision thread and form grinders is offered by The Sheffield Corporation, Dayton 1, Ohio. This illustrated booklet contains a wealth of useful information about these machine tools which accommodate interchangeably a multiform wheel and the conventional single-ribbed wheel.

Niagara Blower Company, 405 Lexington Avenue, New York 17, N. Y., has ready for distribution a new Bulletin, No. 120, on its Aero Heat Exchanger which uses air as the cooling medium by evaporating a water spray. The liquid or gas to be cooled is in a closed system free from contamination.

Fully drip-proof construction is standard with Allis-Chalmers' new squirrel-cage induction motors described in Bulletin 05B7542A. These new motors, with electrical and mechanical protection heretofore found only in specially designed units, will fit a wide range of applications. The publication can be obtained by writing to Box 512, Milwaukee 1, Wis.

*Engineers Manual of Wire Cloth Strainer Design* is the title of a booklet that is believed to be the first of its kind ever published. It is offered free to responsible officials, engineers and designers by Michigan Wire Cloth Company, 2100 Howard Street, Detroit 16, Mich., and gives the reader a step-by-step course in designing strainers to meet his requirements.

Catalogue 10 of The Garlock Packing Company not only contains a complete list of sizes and parts numbers of its oil and grease seals for bearings but also offers detailed information as to how the Klozures provide leakless operation on installations of various types. Copies of this informative 100-page book are available upon request from the company at Palmyra, N. Y.

*Light for Plant Safety and Security* is the title of a 24-page booklet, B-4791, that can be obtained from the Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa. It gives complete plans for lighting outdoor areas such as thoroughfares, building faces, isolated fences and waterfronts and also deals with different power-distribution systems and control as well as mounting methods.

Everyone cutting or machining metals will probably be interested in *Getting Down to Cases on Metal Cutting*, an illustrated 32-page booklet compiled by the metalworking research staff of E. F. Houghton & Co. It goes into actual performance records and gives information on the preparation and use of cutting fluids in various metalworking operations, with special reference to machine feeds and speeds, types of machines, grades of steel and other vari-

ables. Write for a free copy to 303 W. Lehigh Avenue, Philadelphia 33, Pa.

Lignum vitae is the hardest of all hardwoods and is finding increasing use in industry as bearings, bushings, guides, rollers, mallets, etc., according to bulletins prepared by the Lignum-Vitae Products Corporation, 96-100 Boyd Avenue, Jersey City, N. J. The high content of natural resin in this dense and strong product of the tropics imparts to it a self-lubricating quality that is of value in frictional applications. *Engineering Report on Lignum-Vitae* and *Lignum-Vitae Fact Flashes*, sent upon request without obligation, give a reasonably complete story of this industrial material.

Machinists, metallurgists and tool designers will find much useful data on cast-alloy metal-cutting tools in a new 44-page manual and catalogue published by Haynes Stellite Company, a Division of Union Carbide & Carbon Corporation. It gives the physical, mechanical and chemical properties of four different grades of cast cutting-tool alloys as an aid in selecting the right alloy for a given operation. Proper cutting angles, speeds, feeds, depths of cut and other important information are included. The bulletin can be obtained from the Union Carbide & Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.

The Thirty-sixth annual (1951-52) edition of the *Chemical Engineering Catalog*, published by Reinhold Publishing Corporation, 330 West 42nd Street, New York 18, N. Y., is ready for distribution. This comprehensive compilation was inaugurated in 1915 by the American Institute of Chemical Engineers to provide a collected source of condensed and standardized data about equipment, machinery, raw materials, and heavy and fine chemicals for industries using chemical manufacturing processes, with carefully cross-referenced classified indices of such equipment and materials. It continues to serve its purpose well.

A new and larger edition of *Anaconda Tubes and Plates for Condensers and Heat Exchangers* has been issued by The American Brass Company, Waterbury 20, Conn., for engineers responsible for the selection of materials in marine, oil-refining and stationary steam power plants. A 44-page booklet, it discusses the application and installation of condenser and heat-exchanger tubes, also plates for tube sheets, heads and baffles. New research developments are brought out in this publication, and two new subjects are included: operational factors affecting tube life, and corrosion factors in condenser-tube service. Write for Publication B-2.

The nonendowed, nonprofit scientific research organization known as the Armour Research Foundation of the Illinois Institute of Technology has completed its fifteenth year of endeavor and has published a resumé of its achievements in its annual report for 1951. The establishment is supported by industrial concerns and government agencies which contract for its services. Its scientists and engineers specialize in the applied sciences including physics, metallurgy, chemistry and chemical engineering, electrical engineering, ceramics and minerals, heat-power, mechanism and propulsion and structural research. The foundation is growing and hopes greatly to expand its facilities to promote the nation's scientific progress. Appropriations invested by domestic and foreign sponsors of projects reached a total of $6,225,301 during the fiscal year ended August 31, 1951, as compared with $4,614,958 during 1949-50.


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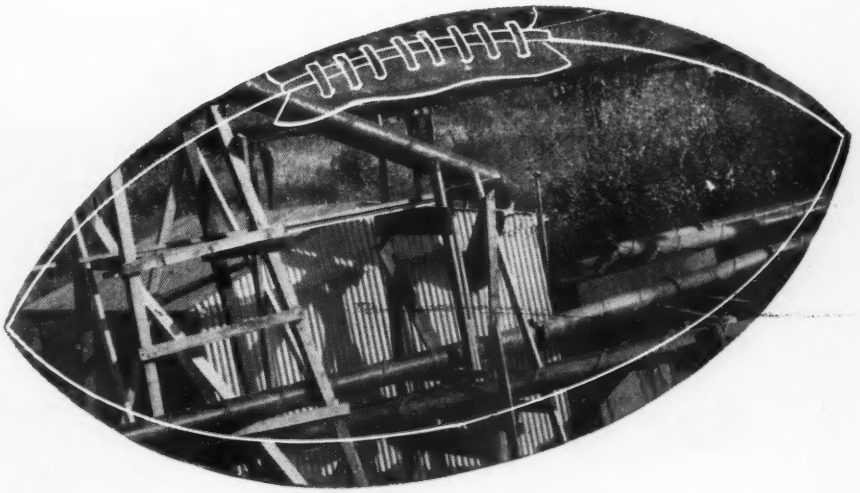

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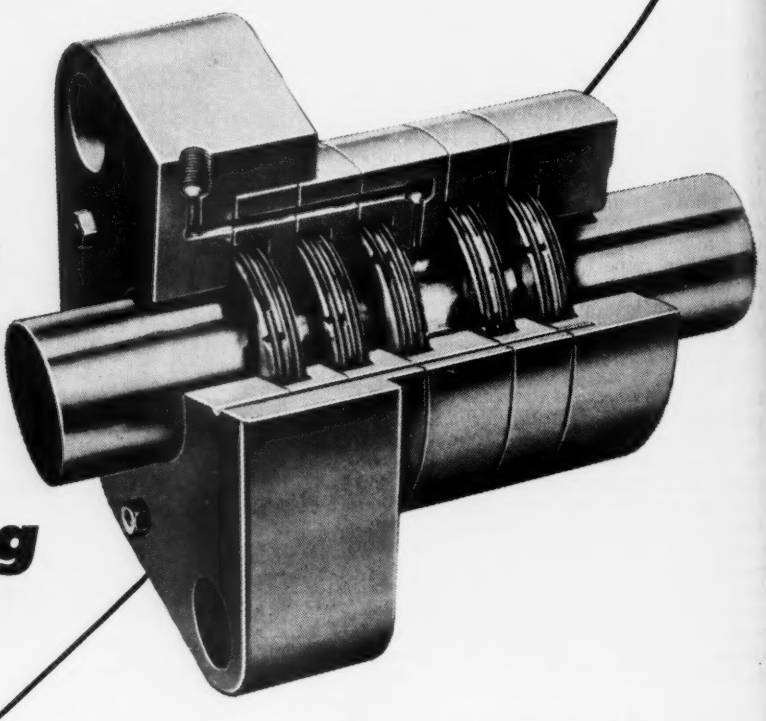

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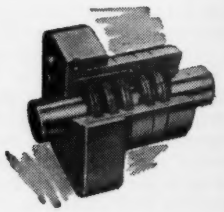

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